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ARCHAEOLOGICAL INVESTIGATIONS ON MOTUTAPU ISLAND, NEW ZEALAND

Introduction to recent fieldwork, and further results

JANET M. DAVIDSON
AUCKLAND INSTITUTE AND MUSEUM

Abstract. Further excavations carried out at Station Bay, Motutapu Island, during 1970/71 are introduced. Radiocarbon dates for site N38/37 and source identifications of obsidians from sites N38/24, N38/30 and N38/37 are described. A prehistoric cultural sequence on Motutapu is outlined.

Archaeological investigations carried out on Motutapu Island under the auspices of the Auckland Institute and Museum are part of a continuing programme of research. A brief description of the island, the advantages it offers for research, and a summary of investigations up to 1968 have been presented elsewhere (Davidson 1970a) together with more detailed reports on some excavations (Scott 1970, Davidson 1970b, Leahy 1970, Allo 1970).

THE 1970/71 SEASON

Another season of fieldwork took place during the summer of 1970/71. While Miss Leahy extended her excavation of site N38/30, previously investigated in 1967/68 (Leahy 1970, Leahy this volume), most of the work was concentrated on site N38/25, the headland pa with adjacent pits at Station Bay, close to the previously excavated undefended sites, N38/30 and N38/37. Results of the excavation of one of the pits adjacent to the pa but outside the defences are presented in a following paper (Sullivan this volume). Analysis of material recovered from the main excavation of the pa is still proceeding, however, and only a preliminary report is presented here.

EXCAVATIONS AT N38/25

N38/25 is a fortified headland with pronounced and well preserved earthworks. Some erosion has taken place on the steep scarps, but in general the surface features of the site are obvious and undisturbed, except for some fossicking by an unknown and irresponsible person during the period 1968-69. The location of the site on a steep narrow headland on the north-east side of Station Bay and its general appearance may be perceived by reference to two earlier papers (Davidson 1970a, Figs. 1 and 2; 1970b, Figs. 1 and 2).

A well preserved transverse ditch (Fig. 1 — b - c) forms the principal defence. This ditch continues for a short distance as a lateral defence on the western side. The largest flat area on the site is immediately inside the ditch. A series of small terraces leads down on either side and up towards the *tihi* (Fig. 1 — d - e) which is a relatively small area surrounded by a scarp on all sides. On the south side of the *tihi* is a particularly high and steep scarp, below which is a terrace similar to but slightly smaller than the *tihi* and bounded on its south side by a second shal-

lower and eroded transverse ditch. Beyond this a long narrow gently sloping area, with a number of indeterminate features, extends southwards, becoming steeper and narrower, until it drops away in a steep razor-backed slope to the rocks below.

Immediately north of the principal defensive ditch is an apparently truncated terrace, which gives some suggestion of continuing down the western slope as a possible earlier ditch. North of this terrace are three large pits, the largest of which was excavated by Sullivan (Sullivan this volume).

The aims of the 1970/71 investigations were several. The site was selected in order to investigate the similarities and differences between this fortified site, and the two undefended sites already excavated in the same bay. In addition to the obvious and perhaps misleading difference between fortified and undefended sites, it was hoped to obtain from the pa evidence about the layout of the site, details of its structures, samples of midden and an artifactual assemblage which could be compared with similar data from the undefended sites. At the same time it was hoped to investigate the uniquely different aspect of the pa, namely the nature of its defences.

Certain internal problems concerning the site itself were apparent. The possible existence of an earlier defensive ditch, inconclusively suggested by surface evidence, required investigation, as did the relationship to the fortified site of the three large and still clearly visible surface pits outside the defences.

Investigation of the largest of the external pits was undertaken as a separate project by Mrs Sullivan, and is separately reported on. Although it is not possible to connect this pit directly by stratigraphic evidence to the interior of the pa sufficient evidence was revealed for the relationship of the pit to the sequence of events inside the pa to be inferred with some confidence.

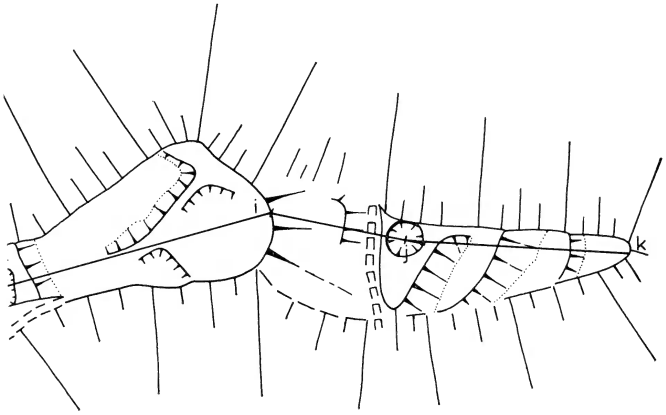
Four other areas of the site were investigated.

The outer terrace

A 4.5 x 1 m trench aligned with the grid of the large pit was set out on the terrace just north of the main ditch. Results here were inconclusive, in that the terrace was shown to be artificial, but not a partially filled ditch, as had been suspected from surface evidence.

The tihi

A single square on the *tihi* revealed a sequence of pit use and abandonment. Earliest features were two parallel pits lying roughly east - west, only parts of which were in the excavated square. The northern of the two, of which a greater area was uncovered, was a fairly small rectangular pit with a single central line of postholes. It had been obliterated by an intentional fill thrown in while a thick layer of bracken fronds was burning in the base of the pit. On the south side of the square a large pit, aligned in a north - south direction, had been cut through the fill of the earlier pit. This later pit had a buttress at the north end, and a scoop hearth at the north-west corner. A double burial of two adults in an extended position had been placed on the floor of the pit, which had then been filled deliberately. The filling of the pits created a surface which became a deliberate floor, as it formed a recognisable level beneath the soil and carried a scatter of small pebbles, and a quantity of small obsidian flakes. No associated features were encountered.



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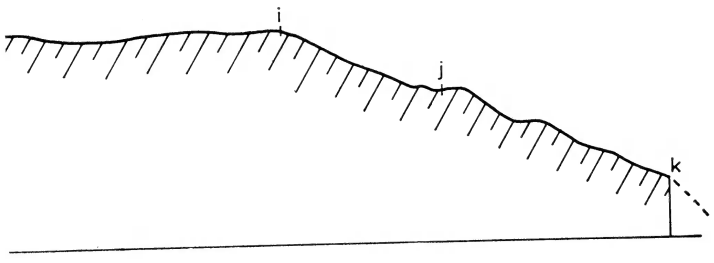

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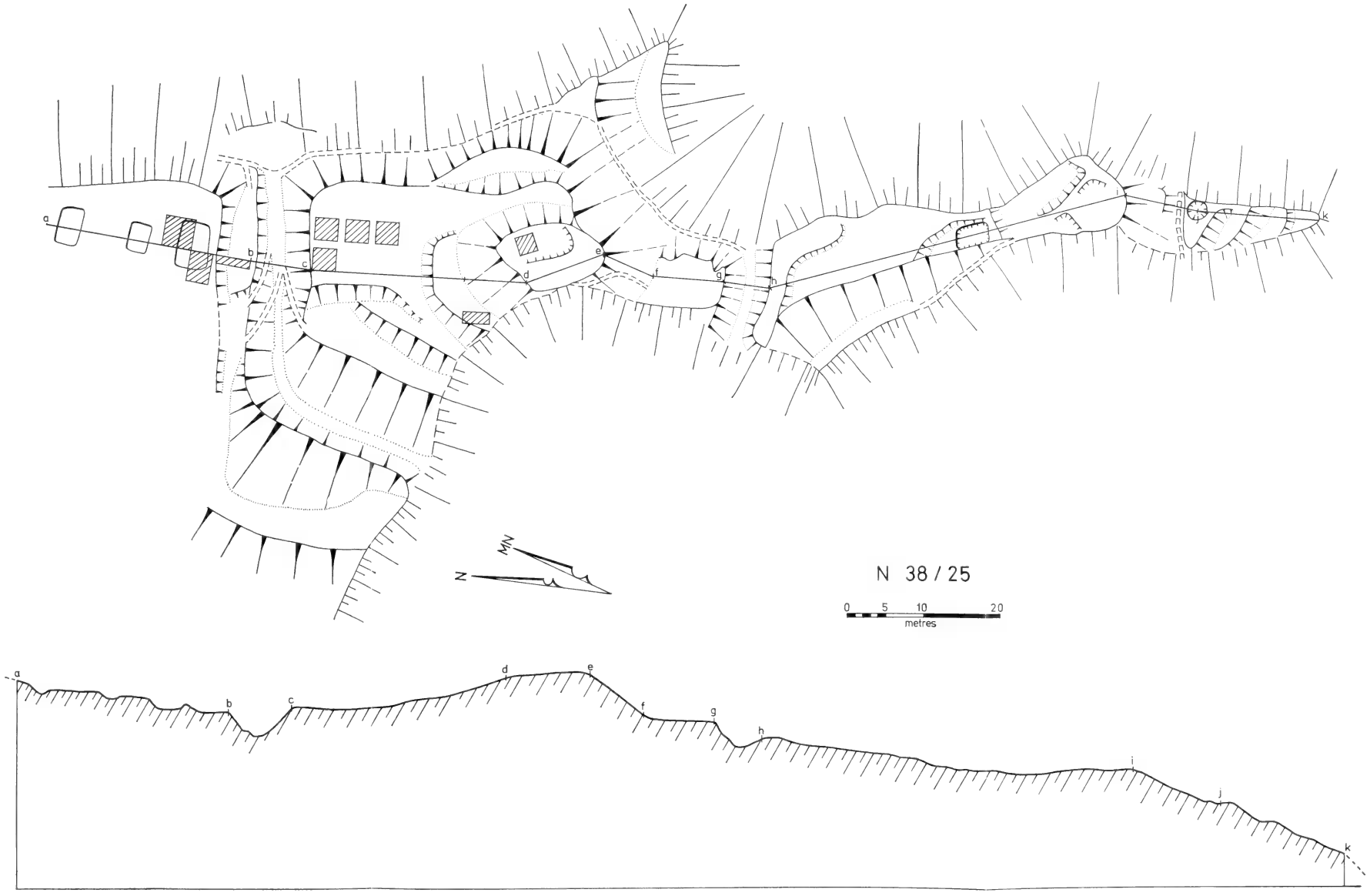

Fig. 1. Plan and profile of site N38/25, the headland pa at Station Bay, Motutapu Island.

Inner terrace

A 3.5 x 2 m area was excavated on the small terrace immediately north-west of the *tihi*. Here a sequence similar to, but simpler than that on the *tihi* was revealed. A rectangular pit had been dug in this area, aligned in the same direction as the terrace. It had a buttress at the southern end, a central row of postholes and no drain. Deliberate infilling subsequently established a hard surface, on which were a couple of very slight fireplaces, and a scatter of obsidian flakes. No other features were recognised.

Central flat area

The bulk of the excavation was concentrated on the flattish area just inside the ditch, where four 3 m squares were excavated. The sequence of events proved extremely complicated, with the result that a smaller area was excavated than had originally been hoped.

The overall stratigraphy in the area was relatively simple; the complexity resulted from the large number of features associated with the major layers, which were as follows:

Layer 1, turf and topsoil over the entire area.

Layer 2, a midden layer of varying thickness, incorporating localised lenses of concentrated shell, and patches of fine ashy midden. Several *haangi* were associated with this layer and it filled a number of postholes of various sizes.

Layer 3, a mixed deposit of yellow clay with scattered midden which filled a number of features, mostly pits.

Layer 4, undisturbed clay derived from weathered greywacke.

Features filled with layer 3 included thirteen rectangular pits of varying sizes and depths, five small rectangular pits (less than 1 m long) with irregular floors, a narrow round-ended pit of a most unusual nature, and about ten palisade postholes. None of the pits was excavated in its entirety, as all either extended beyond the excavated area, or had been truncated by other pits. Of the two largest pits, one showed evidence of two successive floors, while the floor of the other had been broken by several smaller later features. Some of the earliest pits had been filled with particularly hard compacted clay similar to that encountered by Sullivan.

Details of the stratigraphy and features will be presented in the full report of this excavation. A few tentative conclusions, however, may be drawn at this stage, for consideration in the discussion to follow.

The earliest features in the central area seem to have been pits, and some of these apparently preceded any evidence of palisades. The use of the area for pits evidently continued for a considerable period of time, as many pits are cut by other pits. Layer three, which fills all these features, contains little midden and almost no artifacts, suggesting that relatively little other activity took place on this part of the site at this time. A number of the larger pits appear to have been subsequently used in a secondary manner, as Sullivan's large pit was, but layer 3 inside the pa nowhere incorporates the extensive burned and other vegetable matter of Sullivan's pit.

The first palisades inside the ditch may have been constructed while the last of the pits were still in use. Subsequently, however, the pits were all filled in and the accumulation of layer 2 began. The fortifications were renewed along similar lines, and the last set of palisades is filled with layer 2, rather than with layer 3. At this period there was probably a fighting stage associated with the stockade.

Further areas should be excavated on the pa in an attempt to correlate the as yet unrelated sequences from different areas. The following points can be made, however. There are no pits visible on the surface of the pa, but each area investigated revealed a sequence from pits to flat surfaces. Little can be said of the function of the flat surfaces in squares L-4 and I-6, although the quantity of obsidian present on each and the fireplaces on one suggest open work areas, perhaps close to houses. The midden build-up in the central area, however, bears unmistakable sign of a communal cooking and dumping area. So far, then, the limited area excavated at N38/25 suggests greater spatial separation of activities than was apparent at either of the undefended sites, as well as greater intensity of utilisation (in the form of numerous overlapping structures) in the central flat area of N38/25 than on other sites, or, indeed, other areas of this site.

The pits uncovered, in so far as they can be reconstructed, add to the ever-increasing range of structural forms known from Motutapu. Since no two pits uncovered during the 1967/68 season were exactly alike, it is hardly surprising that new proportions and new posthole patterns have emerged from the 1970/71 excavations. N38/25, indeed, has pits larger than any from N38/37 and N38/30, and a range of very small pits unlike any from the other sites.

Analysis of midden and artifacts from N38/25 is not yet complete. Artifacts were very few, and include one small and markedly quadrangular sectioned adze (in contrast to the range of cross-sections on adzes from the undefended sites), one barbed bone fishhook point, and a tattooing chisel. The most notable difference between N38/25 on one hand, and all other Motutapu sites excavated on the other, is the almost complete absence from excavated portions of the pa of adzes and flakes of local greywacke, and hammer stones of local cherts and jaspers. This may be due to insufficient sampling of the more spatially specialised pa; the items may be present in unexcavated parts of the site. On the other hand, obsidian, chert, and greywacke flakes had similar distribution on working floors at other sites, whereas here only obsidian is found. Thus failure to use local rocks may indicate the arrival of another group of people on the island.

During excavation of the midden, a definite impression was formed that this midden contained a far greater proportion of rocky shore shellfish, particularly mussel, than had the undefended sites. In general characteristics, however, and in the predominance of shells and fishbones, and virtual absence of other bones, the middens of the three sites are not too dissimilar.

In conclusion, then, on present evidence the following premises may be established.

1. The pits outside the defences were probably associated with the early stages of occupation of the area before construction of the principal defensive ditch.

2. Surface indications of an earlier ditch are not substantiated.

3. The sequence of occupation activities on the site appears to change from undefended pit complex to defended site with pits as part of the occupation complex, to defended site with few or no pits and discrete activity areas.

4. An important difference between the occupants of the pa on one hand and the undefended sites on the other is the apparent failure of the former to make much use of local greywacke and chert. Further excavation of other areas is needed to substantiate that this is not a result of insufficient sampling.

Further Results from Earlier Seasons

Results of two different kinds of analyses have become available since the publication of the earlier site reports. These results when incorporated with existing evidence, provide a basis for reviewing the entire prehistoric sequence on Motutapu.

Carbon dates from N38/37

Five radiocarbon determinations for charcoal samples from N38/37 are now available (Table 1).

Table 1. Carbon dates from site N38/37.

Sample No.	Description	Age (years B.P.)
NZ 1164	charcoal from base of pit 5	600 ± 40
NZ 1165	charred twigs from undisturbed contexts beneath Rangitoto ash*	600 ± 40
NZ 1166		507 ± 74
NZ 1167		410 ± 73
NZ 1168	charcoal from small *haangi*, fill of pit 1	185 ± 71

* Samples NZ 1165 and NZ 1166 came from square M-8 and sample NZ 1167 from square M-11.

The three samples from beneath the ash (NZ 1165, NZ 1166, NZ 1167) were all of similar material (small charred twigs), and all from an identical stratigraphic context apparently very similar to that from which Golson and Brothers obtained one of two earlier samples used to establish the approximate late 12th century age of the ash shower (Brothers & Golson 1959).

These three dates from N38/37, although from identical contexts within a small area, show some variation, and if the two earlier dates obtained by Golson and Brothers are also taken into account, the variety of dates for the same event is considerable.

Continuing work on the geology of Rangitoto has suggested a continuation of activity there to a time considerably more recent than the date suggested by the earlier determinations for the ash shower. However, there is as yet no evidence that the eruptive cycle included more than one ash shower. Certainly the locations of the three samples from N38/37 are so close horizontally, and so identical stratigraphically, that there can be no doubt that these three samples date the same event. The three results support this in exhibiting no significant difference.

A more recent date for the ash shower would have the effect of compressing the entire archaeological sequence on Motutapu; the most significant result of this

would be that the long sequence of layers containing Archaic artifacts above Rangitoto ash at Golson's Pig Bay site (N38/21) would also be brought closer to the present.

At present, the most that can be said about these samples is that the date of the ash shower must be regarded as less precisely fixed at about 1200 A.D. than was previously thought. In view of the importance of the ash shower as a marker above which considerable Archaic occupation occurred, it is to be hoped that further work may clarify this problem.

The two carbon samples from cultural (post-eruptive) contexts at N38/37 date events which, because of their stratigraphic position, must be later than the event dated by the previous three samples. Sufficient time had passed after the ash shower for the island to become habitable again. Both samples come from the fills of pits which had been dug through the ash into the underlying clay. The determination on sample NZ 1164 (which is identical with the earliest of the three from beneath the ash shower) can only be regarded as an instance of old charcoal or wood being used in, or intruded into, a much later deposit. Sample NZ 1168, however, from a small *haangi* associated with the occupation of N38/37, appears to date an event (the *haangi*) which took place during occupation of the site.

An 18th century date for N38/37 is quite acceptable, although slightly later than was anticipated. The site was previously interpreted as belonging to an Early Maori Phase, with the proviso that it might still be of late date, in view of what was already known about the cultural sequence on Motutapu (Davidson 1970b, p.59).

In sum, then, the carbon dates for this site suggest that the occupation of the site itself may be as late as the 18th century; the age of the Rangitoto ash shower, however, which is so important in the archaeological sequence, appears more uncertain than hitherto.

SOURCES OF OBSIDIAN

A series of obsidian items from N38/37, N38/30 (Station Bay undefended sites) and N38/24 (the Sunde site) was submitted to Dr R. Reeves of Massey University, for source determinations. Details of the analyses are given in Appendix 1.

Five pieces of obsidian from the Sunde site were analysed. These came from levels 2 and 4 above the Rangitoto ash. Only one piece of obsidian had been found beneath the Rangitoto ash, and this had previously been used for hydration rim analysis, and was no longer available. Green (1964) had attributed it to a Mayor Island source, and in view of the repeated confirmation of visual identifications of Mayor Island obsidian there is no reason to question this attribution.

Of the five pieces from levels 2 and 4, two are from the Huruiki source in Northland, one other is probably also from the same source, one is from Mayor Island, and one is significantly different from all sources known at the time the analysis was carried out. Other archaeological samples have been found which do not conform to any known sources, suggesting the existence of either an as yet unknown source, or a significantly different minor flow associated with one of the known major sources (Reeves, pers. comm.).

Two "green" pieces of obsidian, and eleven "grey" pieces from the two undefended sites were selected for analysis. One green and one grey piece were from N38/37 and the remainder from N38/30. The two "green" pieces were confirmed as being from Mayor Island. Despite apparent visual differences, ten grey pieces were found to be from Great Barrier Island (including the single piece from N38/37). The remaining grey piece, not visually different from some of the Great Barrier pieces, was from Whitianga.

The failure of visual inspection by Green and myself to distinguish at all between "grey" obsidian from Huruiki, Great Barrier, Whitianga, and the unknown source shows that future reliance must be on more sophisticated methods of analysis of grey obsidians. On the other hand, continued identification of "green" pieces as of Mayor Island origin, seems reasonable. However, the single piece from the Sunde site identified by Dr Reeves as almost certainly from Mayor Island (on density only), was not recognisably green, showing that Mayor Island sources may also yield some "grey" obsidian.

The results show that Mayor Island obsidian was used throughout the sequence on Motutapu Island, although never as the major source except for the statistically minute sample from beneath the Rangitoto ash at the Sunde site. The Great Barrier Island source, popular during the later stages of Auckland prehistory, may have been unknown until a relatively late point in the sequence, since it is not represented in the Sunde site at all. On the other hand its popularity at site N38/30 is matched by results from other relatively late sites on the Auckland mainland (Green 1964).

The identification of both Huruiki obsidian and an "unknown" source in the post-eruption Archaic layers at the Sunde site is of particular interest. It contributes to a knowledge of the sequence of discovery and exploitation of sources; adds to the very limited knowledge of the cultural relationships of Auckland Archaic; and relates level 2 at the Sunde site, despite its paucity of Archaic artifacts, more securely to the earlier layers at the same site, while distinguishing between that site and the undefended sites, from which no Huruiki obsidian has yet been identified. Unfortunately, the identification of only one of 104 grey pieces from N38/37 is insufficient to rule out the presence in that site of grey obsidian from other sources. The much larger sample from N38/30 is a better indication of the importance of Great Barrier and decline of Huruiki in later times. It is to be hoped that the analysis can be extended in future to include more obsidian from N38/37, as well as a selection from the headland pa N38/25.

Towards a Cultural Sequence on Motutapu

Sufficient work has now been carried out on Motutapu for some consideration to be given to the formulation of a sequence incorporating all the sites so far investigated. Such a sequence must of necessity be tentative, for analysis of results from N38/25 is still at a preliminary stage. Moreover, much depends on the final results from the Pig Bay site, N38/21, the first and in many ways the most important site excavated on the island, which remains unpublished except for preliminary reports. Finally, of course, further fieldwork may shed new light in many areas.

Historical and traditional evidence for the conclusion of the prehistoric sequence are scanty. Transfer of the island from Maori owners to Europeans

probably took place in the early days of European settlement of Auckland. The earliest extant plans (O.L.C. 164, 164A) show Grahame's claim to the south end of the island which was granted in 1857. A later plan (O.L.C. 293) shows the whole island, with Grahame's claim, Maxwell's claim to the northern part, granted in 1870, and a Public Reserve at what is now Administration Bay, gazetted in 1870. Both plans show the island substantially without bush. The earlier shows dead trees in gullies and fern on ridges; the later plan shows one patch of bush on the coast to the north of Station Bay, where the only substantial remnant stand of bush still survives. It is difficult to assess the effect of European ownership on the vegetation in the years preceding the surveys, for the island received only passing mention in early accounts (e.g. Cruise 1957, p.155).

Motutapu, like other Hauraki Gulf islands and eastern parts of the Auckland mainland, was in the possession of Ngati Paoa and allied tribes at the time of European discovery. There appears to have been, however, little indication of actual occupation when the island was first seen and mentioned by Europeans. But at various stages during their occupation of the eastern Auckland area Ngati Paoa are believed to have had settlements on Motutapu. The closing stage of the prehistoric sequence on the island thus belongs to them, and some evidence of their occupation should be present.

Ngati Paoa acquired their Auckand domains by infiltration and conquest from the poorly remembered federation of interrelated tribal groups variously known as Kawerau, Wai-o-hua and by other names. Whether Ngati Paoa were in any way culturally distinct from these earlier tribes is uncertain; whether the arrival of Ngati Paoa on Motutapu and elsewhere in the Auckland area can be documented from the archaeological record is doubtful.

The early part of the archaeological sequence on the island is well represented, although still inadequately dated, by material from the Sunde site (N38/24) and the Pig Bay site (N38/21). Indisputably the earliest deposit yet found is the layer beneath the Rangitoto ash at the former site. Only an imprecise *terminus ante quem* is available for this deposit, and the recent carbon dates tend to suggest that this *terminus ante quem* may be more recent than was formerly thought. Against this, however, can be set Scott's remarks about the date of the layer (1970, p. 17) and the fact that the single obsidian flake from this deposit had a hydration rim greater than any other from the Auckland province (Green 1964). Despite doubts about the age of the ash shower, it still appears reasonable to regard this layer as an early one relative to other known early sites in the Auckland province, as well as in its position in the particular local sequence under consideration here.

Two layers above the ash at the same site yielded artifacts similar to those from below the ash, suggesting the return of a culturally similar group after the eruption. The similarity depends on adzes and fishing gear and their manufacture. A third still younger layer is less certainly associated with the same group of people; there are some similarities of drill points and of adzes in a more restricted range, but no other positive evidence either of similarity or of new traits. For all these layers the only date is a *terminus post quem* which is also the *terminus ante quem* for the earlier layer.

While there is a definite continuity in styles of adzes and fishhooks from beneath the ash at least to level 3 and perhaps to level 2, there is marked change

in economy above the ash. This is reflected in Tables 1 and 2 of Scott's report (1970, pp. 19, 21). At least 19 species of bird, tuataras and fur seals were among the bones from beneath the ash, as well as the dog and fish, which continued in the later layers. By contrast there were five species of bird in level 4, three in level 3 and none in levels 1 and 2. There are just sufficient bones of bush birds in level 4 to indicate slight though very reduced dependence on such. From later layers, however, they have completely vanished, and it is possible to imagine that by the time of the level 3 occupation at this site the vegetation of the island had reached a state not very different from that prevailing in early European times. Failure of the vegetation to follow a natural succession back to coastal forest after this time was probably entirely due to the activity of man.

Level 1 at the Sunde site is not unlike levels 2 and 3 in faunal content, but is so entirely lacking in comparable artifactual material, that it must be considered to be quite different from them, either in the nature of the occupation it reflects, or in the cultural affinities of its occupants, or both.

There is no real equivalent of the pre-eruption layer at Pig Bay (N38/21), but otherwise the sequences are evidently similar. Thus level 1 at the Sunde site is matched by layer 9 at Pig Bay, a similar midden layer without artifacts in contrast to the layers below. It was associated with a hearth from which a 17th century date was obtained (Brothers & Golson 1959). Between this hearth and the ash deposit was a complex and deep deposit of many successive layers, which apparently parallel levels 4 and 3, or 4, 3 and 2 at the Sunde site. The combined evidence from these equivalent layers at the two sites should provide good documentation of material culture of the Archaic phase on Motutapu, for the Pig Bay site was considerably richer in artifacts than the Sunde site.

The interpretation of level 2 at the Sunde site is more important than might be thought. The layer could be regarded as one of a series of Archaic layers whose inhabitants used similar techniques for working the local greywacke. The absence from this particular layer of a wide range of diagnostic Archaic artifacts could merely be due to inadequate sampling. On the other hand, the adzes and flakes of level 2, with their restricted range, include nothing which could not be matched in the material culture of the undefended sites — sites in which diagnostic Archaic artifacts were neither present, nor expected to be present. Much depends on whether a wide range of truly Archaic artifacts was actually present in the middle and upper part of the Archaic sequence of the Pig Bay site as claimed (Golson 1959, p.46); or whether the continuation of greywacke flakes and roughouts, of a more restricted range of types, but still of the same tradition, gave rise to the impression that the full range of the Archaic assemblage persisted until a late point in the sequence, as one preliminary report suggested (Brothers & Golson 1959, p. 576).

The two undefended sites are different in kind from the two sites discussed above; they are situated on ridges, rather than sandy flats by stream mouths, and they contain a range of structural evidence, particularly storage pits, which is naturally missing from the other sites. They also appear to be later than the Archaic sites; one carbon date from N38/37 is late, but in addition to this there is the absence of Archaic artifacts from both sites, and the presence of a few items such as the barbed fishhook point from N38/30 which can be presumed to be

later chronologically than the Archaic hooks. There is a complete absence of bird bones in the undefended sites while dog bones are rare. The lack of Huruiki obsidian and the predominance of Great Barrier obsidian are also significant.

Both the undefended sites, however, contain flakes and evidence of adze manufacture not very different from those of level 2 at the Sunde site. There is a strong suggestion that the same tradition of working the local greywacke continued, even if the types of adze became restricted, and a ground and untanged adze of elliptical or oval cross-section developed as a local variant of the more markedly quadrangular Classic Maori adze of other areas (Leahy 1970, pp. 70-74).

The relative ages of N38/30 and N38/37 are still not known. Certainly it is not likely that the sites are exactly contemporary, nor is it probable that they are separated by a great interval in time. The overall similarities in artifacts and midden, and burial customs seem to outweigh the variations in structures (which are no greater than the internal differences within each site) or the small variations in artifacts and midden. The principal difference between the sites lies in their composition. The excavated area of N38/30 consisted of one house, two pits, a courtyard and a cooking area on a discrete terrace, whereas at N38/37 a larger group of structures was not divided into recognisable discrete units. The terrace at N38/30 can be identified as belonging to a small domestic group. N38/37, however, appears to have been occupied by a larger group which did not accord separate spatial recognition of activity areas to smaller units within it. (Only one cooking area is recognisable at N38/37 to serve a much greater number of structures).

Both undefended sites can tentatively be assigned to the same division of the Motutapu sequence, which in view of differences between these sites and the earlier Archaic deposits, can be designated as a separate phase.

The traditions relating to the Auckland area, although vague as they relate to earlier periods, leave little doubt that warfare was a common aspect of Auckland life from the most remotely remembered times. It was not continuous; periods of prosperity and relative peace occurred which probably lasted many decades. Warfare as such, however, began long before the invasions of Ngati Paoa and Ngati Whatua who were in occupation of the area at the point at which documented history begins. There is no traditional reason to suppose, therefore, that fortifications on Motutapu should all be late, or associated only with the period of Ngati Paoa encroachment.

It was not thought, on the basis of the site survey, that undefended and fortified sites on Motutapu represented chronologically distinct occupations, with fundamentally different settlement patterns. On the contrary, it seemed more likely that both kinds of site could be manifestations of a single culture and type of occupation, although more than one phase could be represented by the total number of such sites on the island. Consequently, the excavation of N38/25 was undertaken partly to test the hypothesis that N38/25 belonged to the same cultural phase as N38/30 and N38/37, rather than the opposite. However, preliminary results outlined above are sufficient to suggest that it is worth examining the the hypothesis that the pa differs from, and is probably later than the two excavated undefended sites.

Widely differing interpretations can be advanced for the apparent differences between the pa and the undefended sites. The apparent difference in midden content of N38/25, not yet verified by full analysis of samples, does not serve to establish that the pa is later. Indeed a preference for rocky shore shellfish is shared with the earlier Archaic sites, and may have one of several other explanations.

The most telling evidence of dissimilarity lies in the differences in material culture and burial customs. These differences have to be judged in the light of other possible explanations. The former, as already explained, could be a result of inadequate sampling of the pa, while the burials on the pa could be the result of hasty burial of war casualties, and so different from the normal peace time procedure. Finally, the much greater spatial separation of different activities on the pa could be a cultural difference, or merely be due to organisation of the pa to meet defensive needs.

A further difficulty arises from the fact that the pa itself has a complicated history. During its early occupation it seems to have been a specialised storage site without associated living debris — and yet it is evident from N38/30 that such debris may be present in one small area and completely absent from a storage pit a very few metres away. On present evidence, however, this debris is absent from the early levels of the pa, leaving little means of determining the cultural affiliations of its inhabitants. It is during the later occupation, when the pa had reached its present form and the layer 2 deposit was accumulating, that the differences between this site and the others are most apparent. It could be argued that the site was first a specialised storage area, and then a fortified storage area, and that it was taken and/or reoccupied by another group of people who, at least while they occupied the pa, were less interested in storage pits than their predecessors.

Only much further work can determine the validity of these speculations. Even if the pa can be shown to be later than the undefended sites and the work of a different group of people, it may never be possible to identify that incoming group of people with Ngati Paoa.

With these uncertainties stated, some outlines of a cultural sequence on Motutapu can be suggested. They may be summarised as follows.

1. Settlement Phase. Represented so far only at the Sunde site. Distinguished by Archaic material culture associated with a very wide range of fauna which was never again available. At the same time, the wide range of bush birds suggests that agricultural clearance was slight or non-existent in this vicinity. Mayor Island obsidian in limited quantity.

2. Archaic Phase. Represented by levels 3 and 4 at the Sunde site, and the lower part of the deposit at Pig Bay. A range of Archaic artifacts, substantial but declining dog population, fishing and shellfish, but few birds in the diet. Agriculture is not represented in the two sites discussed, but the lack of bush birds in the sites suggests a lack of bush, which could be due to clearance. Recent discoveries of early agricultural evidence from less favourable parts of the country suggest that agriculture is by no means unlikely. Some Mayor Island obsidian, but obsidian now obtained predominantly from Northland.

3. Auckland Maori Phase. Represented by sites N38/30 and N38/37. Loss of many Archaic items, particularly fishing gear and some adze types, although tradition of working local greywacke continues. Tattooing present. Obsidian now predominantly from Great Barrier Island, although Mayor Island and Whitianga sources also utilised. Crouch burials in or near occupation sites. This phase is also well represented on the Auckland mainland, notably in recent excavations at Mt. Wellington.

4. Classic Maori Phase. Tentatively identified at N38/25. Distinctively Classic Maori adze and fishhook, tattooing continues. Fortification, decline in agriculture (in favour of fernroot?). Extended burials, which may, however, be a unique local variation. Mayor Island obsidian, but also a grey obsidian, not yet analysed for its source.

Several excavated deposits are not assigned to phases. Level 2 at the Sunde site may belong either to the Archaic, or Auckland Maori Phases. Some layers at the Pig Bay site are similarly uncertain. The uppermost layers at the Sunde and Pig Bay sites probably belong to Classic Maori, but could belong to Auckland Maori. The same applies to the earlier structures at N38/25.

The concept of an Auckland Maori phase requires some explanation. The name is tentative, and in a wider study this manifestation could be regarded as an Auckland Aspect of an Early Maori Phase. The phenomenon designated in this way is seen as one which has a fully "Maori" economy, based on agriculture, fishing, and doubtless fernroot. The material culture, which has lost many of its Archaic elements, can no longer be called Archaic but some Classic traits are also lacking. There is a presumption of continuity from the earlier Archaic Phase with internal change rather than forced intrusion. The Auckland volcanic cones were probably occupied during this phase, and extensive terraced sites on hills and ridges may have been preferred to smaller more compact pa.

The temptation to identify a Classic Maori Phase with invasions of Auckland by Ngati Paoa and Ngati Whatua is strong. The *caveat* expressed earlier in this discussion should not be lost sight of, however. Independent of the tempting framework for interpretation provided by the scanty traditional evidence, there is sufficient archaeological evidence at least to postulate a later phase on Motutapu than that represented by the undefended sites, and one which has closer similarities to Classic Maori, as that term is presently understood.

It will be apparent from the foregoing discussion that this organisation of the Motutapu evidence draws on frameworks previously suggested by Golson (1959) and Green (1963), while differing in some respects from both. This is partly because I have been discussing the prehistoric sequence of an island of less than 4000 acres. More important, however, there is more evidence from different kinds of sites of different ages on Motutapu than has previously been available from any single small area of the North Island. The attempt to organise this evidence seems to raise more problems than it solves. By this means, however, directions for further work are suggested.

Some important questions have not been considered at all, notably the relations of Motutapu to the wider Auckland area, and the many other sites and activities of those Maoris who once briefly occupied one or other of the five sites

discussed here. For while it is theoretically possible for prehistoric Polynesians to have lived permanently on Motutapu, relying solely on its soils and surrounding waters for subsistence, it is unlikely that any did so, if traditional accounts of mobility in the greater Auckland area have any foundation in fact.

However, a start has been made in sketching an outline of what happened on Motutapu throughout its pre-European occupation. That outline must now be expanded and improved, and extended to include not only Motutapu, but adjacent parts of the mainland, and some of the nearby islands — the wider area which was probably also occupied by those who left their mark on Motutapu.

Acknowledgements. Archaeological research on Motutapu Island continues to be made possible through the co-operation and interest of the Hauraki Gulf Maritime Park Board and the Lands and Survey Department. It is a pleasure to acknowledge the assistance of the Commissioner of Crown Lands, Auckland, Mr J. D. O'Brien, and the Superintendent of Land Development, Whangarei, Mr R. K. Somerville, in enabling the 1970/71 fieldwork to take place. The day-to-day interest and co-operation of Mr G. Holmes, Hauraki Gulf Maritime Park Ranger at Rangitoto, and Mr A. McLean, Farm Manager on Motutapu, their families and other residents on Motutapu were greatly appreciated by all those involved in the excavations. Other Lands and Survey officers, particularly Miss A. Soutar, Publicity Officer for the Maritime Park, also deserve our thanks.

I am particularly grateful to Miss Leahy and Mrs Sullivan for their assistance; the former for her continued interest in all aspects of research on Motutapu and many helpful discussions; the latter for her invaluable contribution in organising the camp during the recent season as well as undertaking responsibility for part of the excavation. I should also like to thank all those who took part in the excavations.

The continuing contribution to New Zealand prehistory of the Institute of Nuclear Sciences, Gracefield, and Mr L. Lockerbie, N.Z. Archaeological Association C14 officer, deserves acknowledgement. I should also like to express my appreciation of the work of Dr Reeves and his assistant in sourcing the obsidian samples.

APPENDIX 1

ANALYSIS OF OBSIDIANS FROM MOTUTAPU SITES (communicated by Dr R. Reeves)

A. Obsidians from Motutapu Island undefended sites, N38/30 and N38/37.

Sample No.	% Na	% K	% Fe	ppm Mn	ppm Zn	Density (gcm^{-3})
743B	3.39	4.03	0.98	199	44	
761	3.37	3.97	0.96	196	43	
773A	3.36	3.88	0.96	195	42	
773B	3.39	4.03	0.98	196	40	
782A	3.26	3.92	0.97	196	41	
782F	3.48	3.98	0.97	199	40	
782E	3.27	3.87	1.02	212	43	
810	3.41	4.03	0.98	213	48	2.361
855B	3.41	3.90	0.96	198	44	
882	3.33	3.93	0.95	207	44	
Typical Great Barrier I. analyses	3.30 3.33	3.95 3.92	0.99 0.94	205 200	44 43	
743C			not determined			2.389
782C	4.52	3.57	3.20	702	222	2.396
Typical Mayor I. analyses	4.60 4.59	3.63 3.61	3.21 3.27	700 695	211 222	

Sample 743C has a density consistent with a Mayor Island origin.

743A	3.78	2.93	1.02	447	42	
Typical Whitianga analyses	3.87 3.71	2.87 2.84	1.03 1.00	443 439	45 42	

Conclusion. Ten samples are of Great Barrier I. origin, one of Mayor I., one Mayor I. probable, and one of Whitianga.

B. Obsidians from the Sunde site, Motutapu Island.

Sample No.	% Na	% K	% Fe	ppm Mn	ppm Zn	Density (gcm^{-3})
1570/3A	4.20	3.26	1.05	216	47	2.361
1574/4	4.21	3.20	1.01	217	59	2.361
Typical Huruiki analyses	4.09	3.12	1.06	225	55	
	4.17	3.13	1.01	228	48	
1572/4	not determined					2.365

Density of sample 1572/4 is within the range exhibited by Huruiki obsidian, although there is an overlap with Whitianga densities at about this point.

1570/3B	not determined					2.418

This density is within the range shown by Mayor Island obsidians.

1568/9	3.51	3.47	0.77	381	31	

Sample 1568/9 is one of a small number of really baffling archaeological specimens we have examined. This set of figures does not correspond to any of the natural sources we have studied.

Conclusion. Two samples are of Huruiki origin, one Huruiki probable, one almost certainly Mayor I., and one is of unknown origin.

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FURTHER EXCAVATIONS AT SITE N38/30, MOTUTAPU ISLAND, NEW ZEALAND

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Abstract. During the 1970/71 season additional excavations at site N38/30, an undefended site on Motutapu Island, provided the remaining information required to define all the structural features belonging to one of the occupation terraces.

In the summer of 1970/71 two weeks were spent extending the excavation at site N38/30 to uncover all occupation features on one of several terraces which constitute the site (Fig. 1). The terrace had been partly excavated during the 1967/68 season and the results described (Leahy 1970). In 1970/71, excavations were continued in the north and east portion of the terrace.

Two further areas were opened, employing the original grid, and numbered squares 3 and 4 (Fig. 2). Square 3 was a 4 m square reduced by 1 m baulks left along the west and south lines. Square 4 extended north and east of square 3 as a 2 x 2.5 m unit. Subsequently some extensions were made to explore various features exposed during excavation.

Datum was re-established 20 cm above the turf at point "Z" (Figs. 2 and 4).

DESCRIPTION OF LAYERS AND FEATURES

(Figs. 3 and 4)

The layers encountered were consistent with those established during the previous excavation, and where present have been given the same numbers (cf. Leahy 1970, pp. 62 - 67). Layer 3 was absent from both squares, while layer 2 was present only in an extension to square 3.

The remaining layers, 1 and 4 to 8 were present in both squares.

Layer 1. Square 3. This consisted of the natural clay base which formed a flattish surface sloping gradually to the south side of the square. Various pits and postholes had been dug into it. In the north-east corner was one edge of a pit (pit 4, Fig. 3) with a floor 50 cm below the clay surface at a depth of 120 cm below datum. The pit, filled with layer 6, extended into square 4.

Cutting across the south-east corner of the square was part of a shallow pit (pit 5, Fig. 3) with a floor 30 cm below the clay surface and 126 cm below datum. One of its corners appeared just inside the square close to the south baulk.

Extensions were made to the south-east of square 3 to expose the east end of this pit. The first extension, 1 x 0.5 m, set out at an angle, revealed that the pit terminated in a low rounded bank into which had been dug a large posthole (post-hole 5). A further extension, 50 x 60 cm, defined this posthole.

Rec. Auckland Inst. Mus. 9: 15-26 December 15th 1972

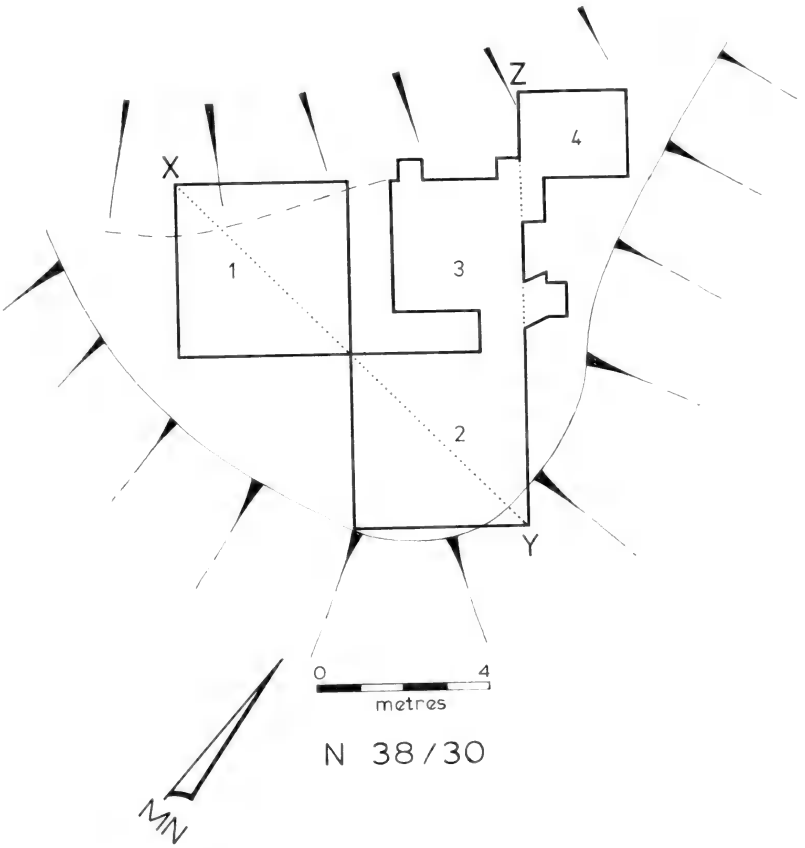
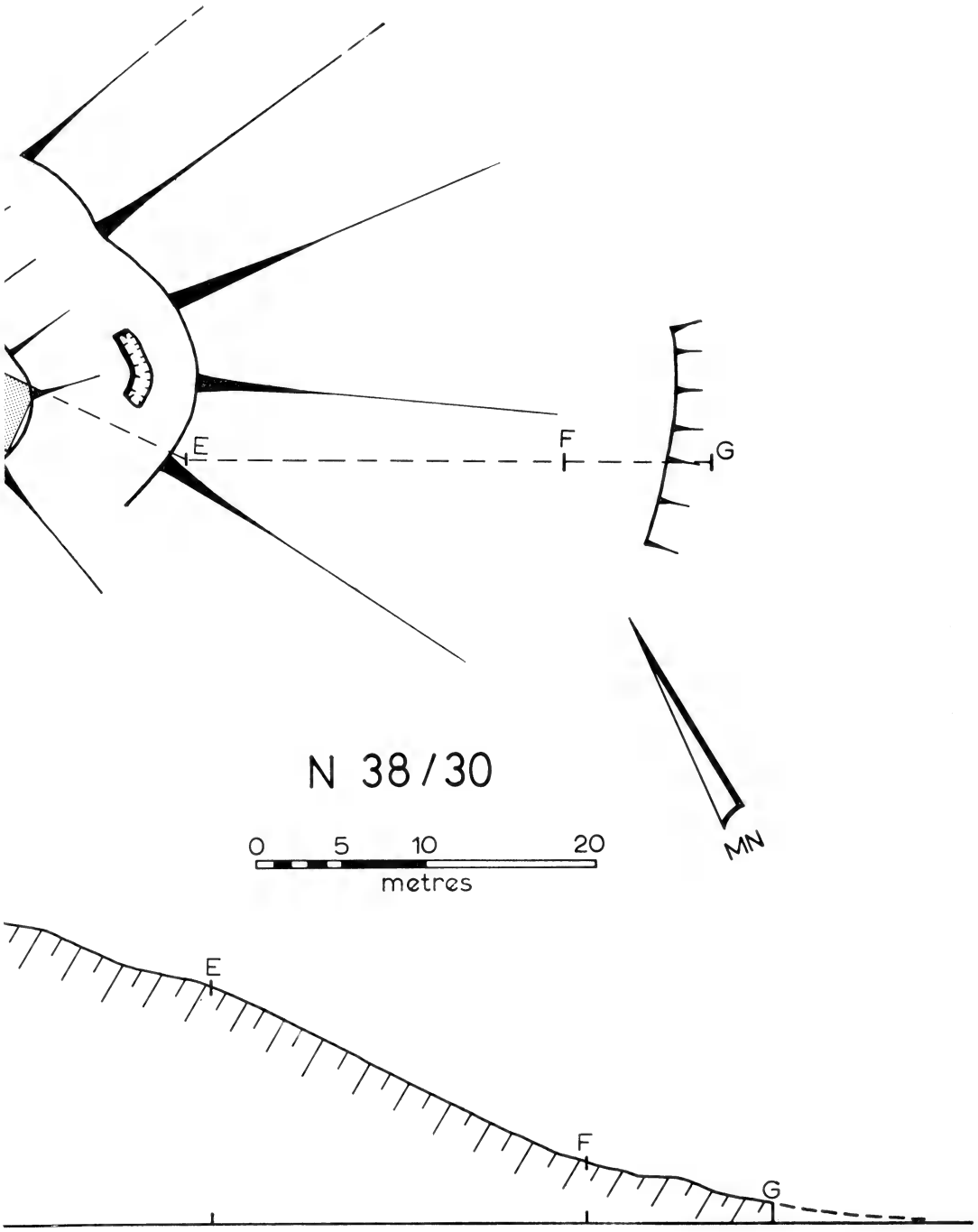


Fig. 2. Ground plan of excavated area, N38/30.

Another extension in the form of a 1 m square through the east portion of the south baulk permitted the other edge of pit 2, first encountered in square 2, to be established. However, the fill of this pit was not excavated as time did not permit.

Pit 5, when fully defined, was 1 m wide and 1.6 m long. The north edge and part of the west edge were straight sided but on the south side the edges were more indistinct and rose as a low bank which then sloped down to where the fill of pit 2 commenced. At the north-east end, the edge became less distinct and curved round to join the raised edge of the large posthole. It appeared that the posthole had been dug into the natural and the pit later dug below the clay surface so that the pit edge in that area was formed by the lip of the posthole. The east end of the south wall just showed as a slight edge in the baulk extension and suggested a continuation of the rounded edge further back.

Within pit 5 were four postholes. Posthole 1 was centrally placed. It was 10 cm in diameter, 15 cm deep and 155 cm below datum at its deepest point. It was filled with blackish earth and clay rubble. Posthole 2 at the west end was inserted into the bank of the pit so that the west edge of the hole was higher than the east side. It was 20 cm across, 20 cm deep and 134 cm below datum. It was filled with a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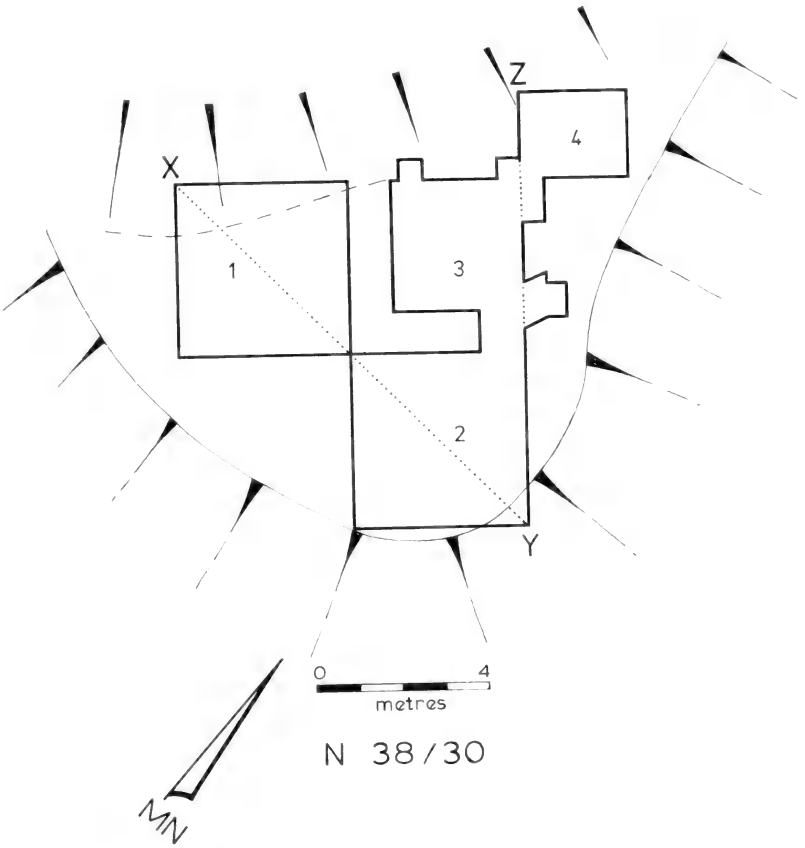

Fig. 2. Ground plan of excavated area, N38/30.

Another extension in the form of a 1 m square through the east portion of the south baulk permitted the other edge of pit 2, first encountered in square 2, to be established. However, the fill of this pit was not excavated as time did not permit.

Pit 5, when fully defined, was 1 m wide and 1.6 m long. The north edge and part of the west edge were straight sided but on the south side the edges were more indistinct and rose as a low bank which then sloped down to where the fill of pit 2 commenced. At the north-east end, the edge became less distinct and curved round to join the raised edge of the large posthole. It appeared that the posthole had been dug into the natural and the pit later dug below the clay surface so that the pit edge in that area was formed by the lip of the posthole. The east end of the south wall just showed as a slight edge in the baulk extension and suggested a continuation of the rounded edge further back.

Within pit 5 were four postholes. Posthole 1 was centrally placed. It was 10 cm in diameter, 15 cm deep and 155 cm below datum at its deepest point. It was filled with blackish earth and clay rubble. Posthole 2 at the west end was inserted into the bank of the pit so that the west edge of the hole was higher than the east side. It was 20 cm across, 20 cm deep and 134 cm below datum. It was filled with a

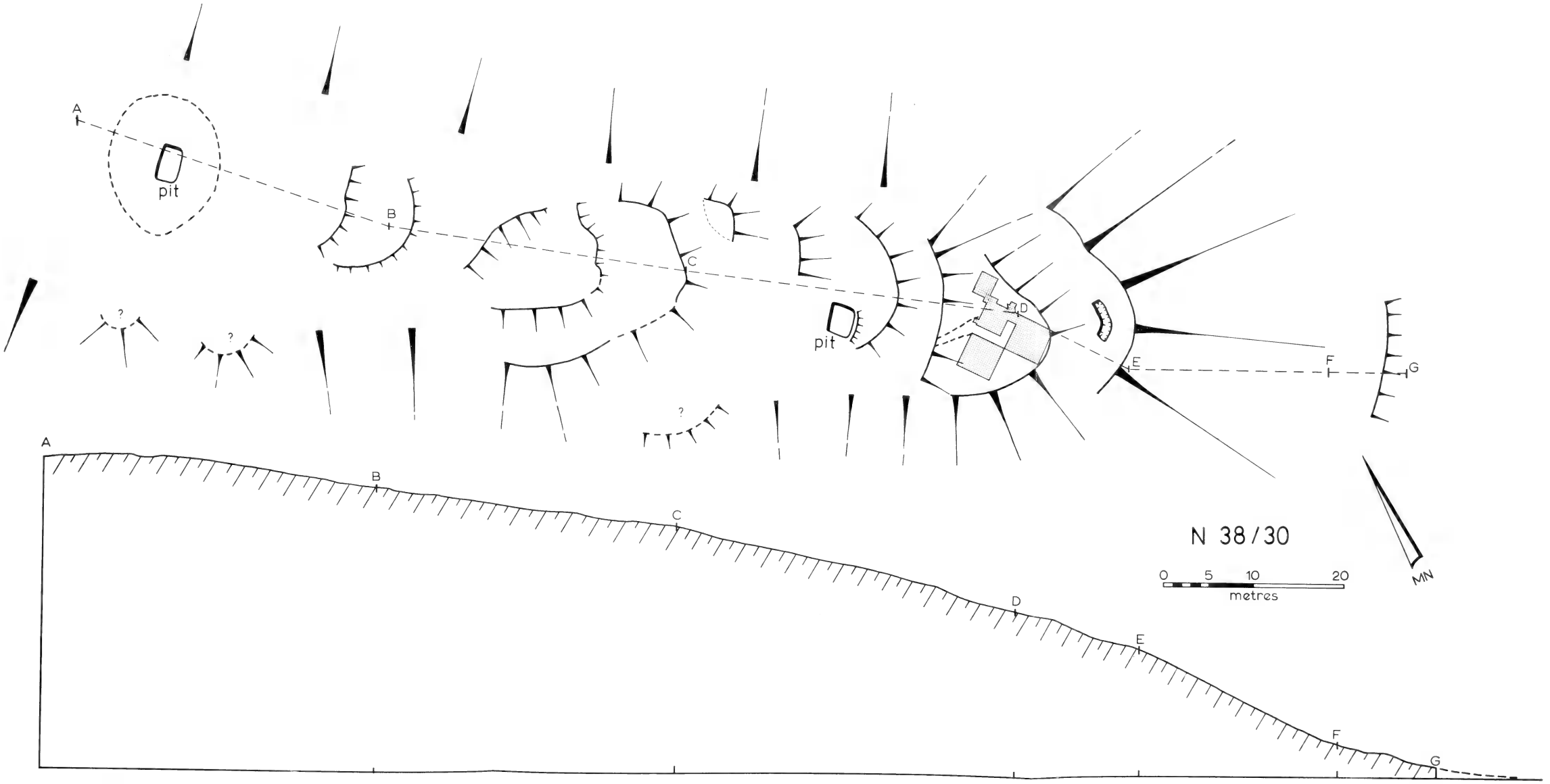

Fig. 1. Longitudinal survey plan of ridge on which site N38/30 is situated.

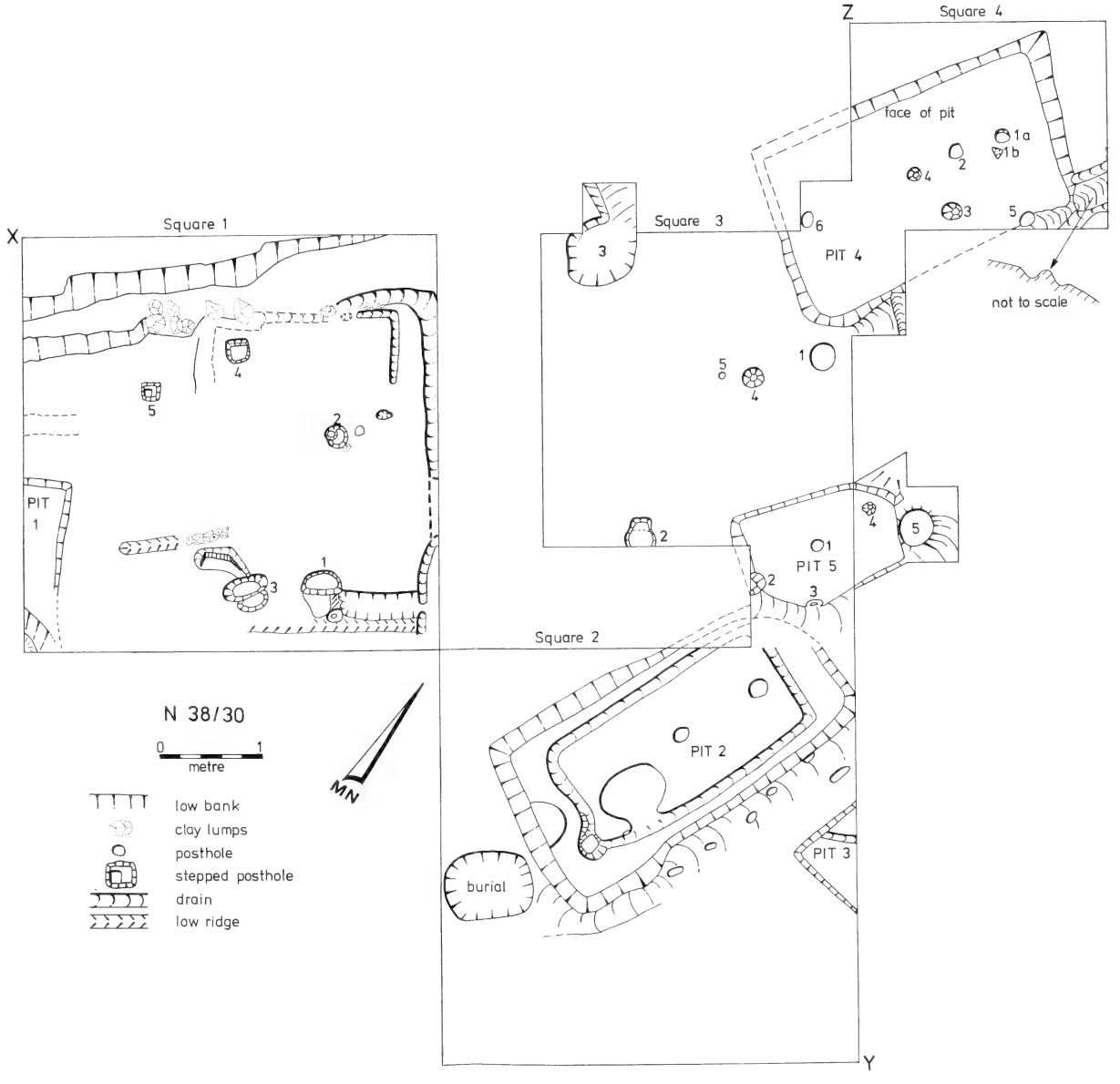

Fig. 3 Plan of features revealed by excavation, N38/30.

brownish sandy and clay rubble. Posthole 3 was more slot-like and was situated at the rounded edge of the south bank. It was 16 cm long, 8 cm wide and 10 cm deep. It narrowed to a flat point at 148 cm below datum. The fill was similar to posthole 2. Posthole 4 was placed to the north of the central line. It was 12 cm across, 14 cm deep and 154 cm below datum, and was filled with a browny black earth and fine clay rubble.

Posthole 5, situated just outside pit 5, was 32 cm across, 36 cm deep and 166 cm from datum. It was filled with browny grey rubble.

Other features in square 3 were two postholes and a basin-shaped depression. Posthole 1, in the flattish clay floor near the east baulk and just outside the corner of pit 4, was filled with a browny green material containing some midden. This same material appeared in the baulk and extended a short way out over the square, filling and covering the hole. This hole was 26 cm across, 16 cm deep and 96 cm below datum.

Posthole 2 was a shallow square-stepped hole similar in shape to those in square 1 that were associated with the house structure. It measured 20 cm across, 6 cm deep and was 104 cm below datum. It had a very thin layer of browny green material in the lower portion and then was filled with black layer 6.

Postholes 4 and 5, near the centre of the square, were associated with layer 6.

Layer 1. Square 4. Pit 4 occupied most of this square, although in the north and east were exposed portions of the scarp bank into which the corner of the pit had been dug. The pit was 3 m long and 1.7 m across. The floor was 1.26 m below datum in the central area and sloped slightly to the south to 1.3 m below datum. It was deepest in the south-east corner (1.34 m) suggesting that drainage, if necessary, would occur at that end of the pit. Unlike pit 2, it contained no artificial drain in the floor surface.

Pit 4 contained seven features, six postholes and one dip in the south-east wall.

Posthole 1a was 16 cm across, 40 cm deep and 166 cm below datum in its deepest part. It was filled with rubbly grey clay and two broken stones deep in the hole, with a thin upper layer of black earth (layer 6) which extended into a "V-shaped" hole (1b) near it. The latter hole cut back into posthole 1a and was filled with the black earth of the layer 6 fill of the pit. Posthole 2 was 14 cm across, 39 cm deep and 164 cm below datum. Its fill was similar to that of 1 a. Posthole 3 was 20 cm across, 27 cm deep, 153 cm below datum and was angled, the bottom of the hole being 3 - 4 cm south of the lip of the hole. Its fill consisted of rubbly clay below and a few clay lumps above. Posthole 4 was in line with holes 1 and 2 but slanted in the same direction as hole 3, although not as sharply. It was 14 cm across, 16 cm deep and 142 cm below datum. The hole was packed with small lumps of clay and may have been deliberately filled. The top few centimetres were covered with layer 6. Posthole 5 was situated at the base of and partly dug into the bank at the east end of the south wall of the pit. It was 16 cm across, 19 cm deep and 153 cm below datum. It had been tightly packed with clay lumps and its full extent was only discovered when a piece of stone was found to extend deep into the wall of what had been thought to be a stakehole. Posthole 6 was uncovered when a 50 x 50 cm extension was cut in the baulk at

the west end of square 4. It was oval shaped, 16 cm across, 29 cm deep and 155 cm below datum. It was in line with posthole 1 along the long axis of the pit. The fill was a rubbly grey-brown earth with clay bits.

The other feature was a depression just beyond the wall of the pit at the south-east end. The height of the pit wall dropped on the east side to about 8 cm and then rose again to about 24 cm above the floor. Careful investigation failed to show any direct opening to allow drainage from the pit into the depression outside although the pit was deepest in that corner.

The north-west corner of pit 4 and part of the south wall were not excavated, although a final 1 x 0.5 m extension in the south-west corner of square 4 exposed the south-west corner of the pit. The bank edge, about 24 cm high at this point, rose to a height of about 50 cm in the north-east corner of square 3, where it entered the baulk.

Layer 2. Square 3. This was a greenish brown sandy material, identified as Rangitoto ash. There was no trace of it in square 3 but it appeared as a thickish contoured overlay on the clay natural at the east end of the angled extension in the deep hollow behind the large posthole (5). It did not reach into the pit itself. It was covered by layer 6.

Layer 4. Square 3. A browny green material containing some midden material appeared in the east wall of the square. It formed a thin layer extending about a square metre out over the clay and filling posthole 1 and pit 5.

Layer 4. Square 4. A rather thick layer of what appeared to be Rangitoto ash rested in the hollow behind the pit edge in the south-east corner of the square. It contained some charcoal flecks and a half pipi shell near the clay natural showing that it had been redeposited. The east floor behind the pit where the bank dropped away showed an increasing depth of material. It was probably deposited down the slope when the pit was being built.

Layer 5. Square 3. Butting against the west wall of pit 4 was what appeared to be a buttress consisting of lumps of clay pressed together. The lumps did not seem to form a solid mass and were eventually removed. The flat floor of the pit beneath showed a thin grey layer of water washed clay and earth. This buttress-like feature might have been formed by clay lumps falling from the bank edge after abandonment of the pit; against this interpretation, however, is the fact that the bank appeared stable and straight in this area. Alternatively, the feature could have been an off-centre, unfinished buttress, representing a second use of the pit, and so corresponding to the secondary floor (layer 5), previously found in square 2 (Leahy 1970, p. 66).

Layer 5. Square 4. Between postholes 1, 2, 3, and 4 in pit 4 was a solidly packed clay pan, overlying a thin layer of grey-yellow earth similar to the water-deposited silt found under the possible buttress at the west end of the same pit and under the redeposited floor of pit 2. This pan of clay could possibly have been the residue removed from one of the postholes in pit 4 when there was some realignment or rearrangement of the structures associated with the pit.

Layer 6. Square 3. This covered the whole square and extensions. Towards its base clay particles were more frequent while all the pits contained a considerable number of clay lumps ranging from about 10 cm in diameter down to fine rubble interspersed with black soil, midden material, charcoal scraps and *haangi* stones. These lumps were probably from natural weathering of the bank edges. Layer 6 was fairly thin where it was distributed over the flattish surface of the square, but formed the main fill of pit 4.

In the south-east corner of the square, over and also a bit back from the fill of pit 5, was an irregular clay walling consisting of two interjoined square areas and a squarish internal depression. This contained a circular collection of *haangi* stones. The walls were very fragile and it was impossible to prevent the clay lumps from crumbling in most parts as they were excavated. No function was indicated except possibly as an edge or windbreak for the *haangi* on the south side. Because one of the small enclosures faced north and the other west, while the walling was not more than 15 cm high, interpretation as a windbreak seems unlikely. The walls rested on layer 6 material. Part of this clay area continued on into the 1 m extension where layer 6 covered pit 5.

Posthole 4 appeared to have been dug from a surface within layer 6. In its deepest part it was dug into the clay floor to a depth of 12 cm and filled with layer 6. It was oval in shape, 14 cm x 18 cm, and sloped inwards, terminating in a small central depression. It was 92 cm below datum at its deepest point. About 40 cm west of this was a stake hole also associated with layer 6. This entered the clay to a depth of about 5 cm.

Small amounts of shell and bone were found scattered throughout layer 6. In the eastward extension of square 3, dug to establish the corner of pit 4, was a discrete collection of bird and rat bone.

Layer 6. Square 4. This covered the whole square and formed the bulk of the fill of pit 4. On four occasions *haangi* or firepits were dug in the fill; one at the west end, one in the middle (a small collection of midden material was found associated with this), and two in the same spot on the south side. Clay lumps, probably from the partially exposed banks, helped to fill the pit during the build up of layer 6. A narrow depression at the east end of the square and partly in the baulk, formed a depression in the clay bank at the back of the pit. It was not well defined and could possibly have been a root hole. Layer 6 in this square contained a number of *haangi* stones.

Layer 7. Squares 3 and 4. This layer covered the site and was difficult to distinguish from the turf covering. It contained a number of stones. In square 4 it sealed off layer 6 and filled features dug into it in three places. There was a large firepit with orange brown ash above and black ash and charcoal below similar to that previously described for layer 7, square 2. Two other small firepits were encountered near-by in the central part of the shallow depression in pit 4.

Layer 8. Squares 3 and 4. Layer 8 consisted of the turf which covered the entire surface of the site.

Artifacts

One small squarish grinding stone *(hoanga)* was found in layer 6, square 3, towards the south end of the west baulk. It measured 7 x 7 x 3 cm. One corner

showed evidence of abrasion or wear as a smoother depressed area, suggesting that it had been used on smaller rather than larger objects. If the stone was held in the hand only one quarter of it would be exposed and available for use.

No obsidian was found in this excavation. One greywacke flake, 3 x 3 cm, was found in the layer 4 fill of pit 5.

One small piece of pumice, found in layer 1, square 3, was identified as Loisels pumice by B.P. Kohn (pers. comm.) who described this type as "... usually a dark pumice containing light and dark bands." The pumice must have been carried to the site although its transportation could have been incidental to some other material.

MIDDEN

Shell

Most shells found were in a fragile condition. Because of this they could not be properly cleaned and were not weighed. The number of shells present is given in Table 1. The shells tended to be in the small to medium range rather than large.

Table 1. Occurrence of all shells by number in layers 4 and 6, Squares 3 and 4, N38/30.

SHELL SPECIES	LAYER 4 Square 3	LAYER 4 Square 4	LAYER 6 Square 3	LAYER 6 Square 4
Rocky shore species				
Cellana radians	—	—	—	present
Cookia sulcata	—	—	—	5
Crassostrea glomerata	—	—	—	2
Haliotis sp.	—	—	present	present
Hiatella arctica	—	—	—	1
Lunella smaragda	13	—	36	271
Maoricrypta constata	1	—	—	4
Mytilus sp.	present	—	—	3 (½ shells)
Neothais scalaris	1	—	present	12
Zediloma arida	—	—	present	12
Sandy shore/mudflat species				
Amphidesma australe	1 (R. valve)	1 (½ shell)	6 (R. valve)	39 (R. valve)
A. subtriangulatum	—	—	1 (½ shell)	2 (½ shells)
Chione stutchburyi	present	—	8 (L. valve)	24 (L. valve)
Cominella sp.	—	—	present	2
Dosinia sp.	1 (½ shell)	—	present	1 (½ shell)
Maoricolpus sp.	—	—	—	11
Pecten novaezelandiae	—	—	present	present

A single valve of *Hiatella arctica* was found in layer 6, square 4. This small shell nestles in crevices of all kinds, for example in holdfasts of kelp and crevices of larger shells (A.W.B. Powell, pers. comm.); Morton and Miller (1968, p. 224)

showed evidence of abrasion or wear as a smoother depressed area, suggesting that it had been used on smaller rather than larger objects. If the stone was held in the hand only one quarter of it would be exposed and available for use.

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Table 1. Occurrence of all shells by number in layers 4 and 6, Squares 3 and 4, N38/30.

SHELL SPECIES	LAYER 4 Square 3	LAYER 4 Square 4	LAYER 6 Square 3	LAYER 6 Square 4
Rocky shore species				
Cellana radians	—	—	—	present
Cookia sulcata	—	—	—	5
Crassostrea glomerata	—	—	—	2
Haliotis sp.	—	—	present	present
Hiatella arctica	—	—	—	1
Lunella smaragda	13	—	36	271
Maoricrypta constata	1	—	—	4
Mytilus sp.	present	—	—	3 (½ shells)
Neothais scalaris	1	—	present	12
Zediloma arida	—	—	present	12
Sandy shore/mudflat species				
Amphidesma australe	1 (R. valve)	1 (½ shell)	6 (R. valve)	39 (R. valve)
A. subtriangulatum	—	—	1 (½ shell)	2 (½ shells)
Chione stutchburyi	present	—	8 (L. valve)	24 (L. valve)
Cominella sp.	—	—	present	2
Dosinia sp.	1 (½ shell)	—	present	1 (½ shell)
Maoricolpus sp.	—	—	—	11
Pecten novaezelandiae	—	—	present	present

A single valve of *Hiatella arctica* was found in layer 6, square 4. This small shell nestles in crevices of all kinds, for example in holdfasts of kelp and crevices of larger shells (A.W.B. Powell, pers. comm.); Morton and Miller (1968, p. 224)

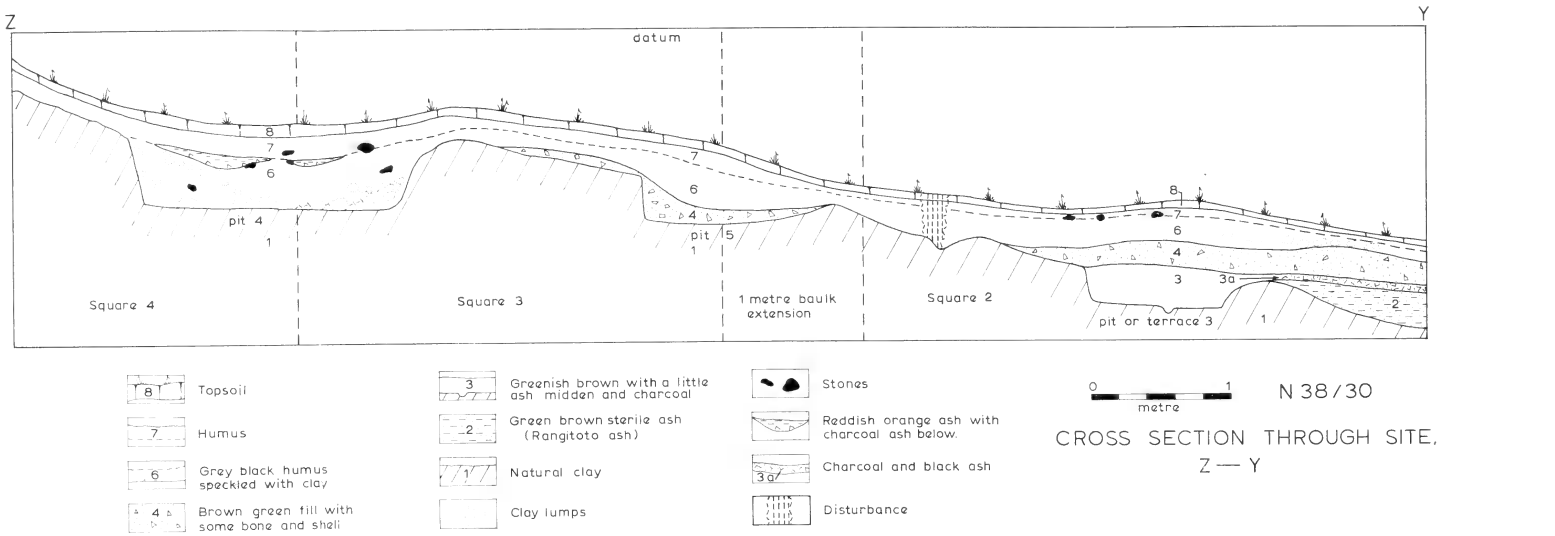

Fig. 4. Cross-section through site, N38/30.

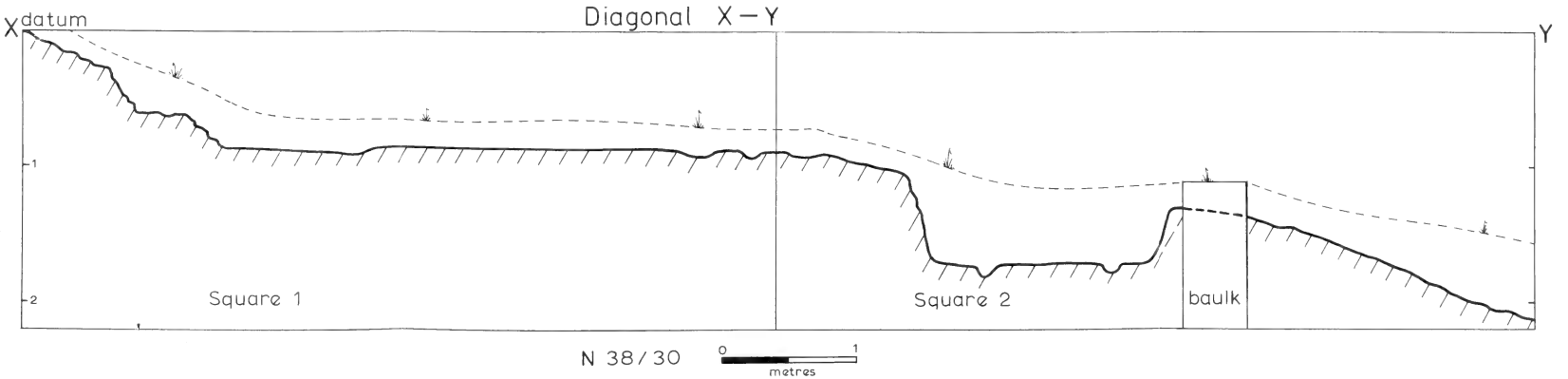

Fig. 5. Diagonal through site showing elevation, N38/30.

also described it as a kelp dwelling species. This shell could indicate the use of kelp on the site.

In the fill of the pit in square 4 was a small depression which contained a collection of shells and fish bones. This could be the debris of one meal. The fish bone included two snapper *(Chrysophrys auratus)* upper pre-maxillae from small fish weighing probably not more than 1.36 kg (3 lbs). The shell content (which is included in Table 1) is shown in Table 2.

Table 2. Occurrence of shell in depression in pit fill, Square 4, N38/30.

Rocky shore species	
Cookia sulcata	3
Crassostrea glomerata	1, ½ shell
Haliotis sp.	broken pieces
Hiatella arctica	1 valve
Lunella smaragda	154, mainly small shells
Maoricrypta sp.	2
Mytilus sp.	1, ½ shell
Neothais scalaris	7, 1 very small
Zediloma sp.	5
Sandy shore/mudflat species	
Amphidesma australe	21 (right valves counted)
A. subtriangulatum	1, ½ shell
Chione stutchburyi	9 (left valves counted)
Cominella sp.	2
Dosinia sp.	1, ½ shell
Maoricolpus sp.	7
Pecten novaezelandiae	broken pieces

Bone

Most of the fish bone present in the site was snapper *(Chrysophrys auratus)* but parts of a barracouta jaw *(Thyrsites atun)* were found in layer 6, square 4. The opercular cover of an unidentified fish (not snapper) was found in layer 6, square 3. Identifications were made by Mr A. B. Stephenson.

Just below the turf in layer 7, square 3, the skeleton of a small lamb was found. It appeared to be of recent origin.

Part of the proximal end of a left humerus of a young dog was found in the fill of pit 5, layer 4, in the south extension of square 3.

Rattus exulans limb bones, probably from one individual (R.J. Scarlett, pers. comm.) were found in the east extension of square 3, just at the edge of pit 4 in the layer 6 fill. Associated with the rat bones were several bird bones which have been identified by R.J. Scarlett (pers. comm.) as the left humerus of a marsh crake *(Porzana pusilla affinis)*, and several bones of an unidentified Passeriform or perching bird, probably from one individual.

Stone

Both *haangi* stones and assorted local stones showing no obvious evidence of use as *haangi* stones were found in the excavation. Distribution of both kinds is shown in Tables 3 and 4.

Table 3. Occurrence of stone other than *haangi* stones, Squares 3 and 4, N38/30.

Square 3, south extension, layer 4	greywacke	57 gm
Square 3, layer 6	assorted	402 gm
Square 4, layer 6	assorted	634 gm

Table 4. Occurrence of *haangi* stones, Squares 3 and 4, N38/30.

	SQUARE 3		SQUARE 4	
	Layer 6 kg	Layer 7 kg	Layer 6 kg	Layer 7 kg
Fractured	23.5	3.0	34.75	7.0
Pebble	16.0	6.0	43.25	4.5
Total	39.5	9.0	78.0	11.5

Discussion

The 1970/71 excavation, while confirming the previous results, added new information about the extent and types of features on the site (see Fig. 3).

The first excavation results (squares 1 and 2) had suggested that the terrace originally dug into the ridge contained a surface house structure which was subsequently modified and a semi-subterranean storage pit with a buttress, two postholes, and an internal drain. The pit was also subsequently modified. Sealing these features was a black earth layer, layer 6, which contained numerous stone flakes, adzes and other artifacts. A subsequent more restricted occupation was indicated by fire pits in the surface of layer 6.

The two 1971 squares, squares 3 and 4, extended the excavated area by 7 square metres. The original occupation in square 3 (layer 1) consisted of a flattish weathered clay surface about 2.5 metres square which contained few structures, these being mainly on the periphery of the square. The flattish area suggested a courtyard bounded by the scarp of the bank, pit 2 and pit 5 on the south and pit 4 on the east side. On the west would have been the house structure. A path down the ridge ran between the house and the courtyard. A diagonal cross-section (Fig. 5) through squares 1 and 2 (Figs. 2 — X – Y) shows the relative elevations of the house, corner of the courtyard and pit 2.

The courtyard area would have been sheltered, secluded and a suitable centre for the activities associated with the settlement. A stamped path led from the front of the house, which faced south, to the ridge path on the west side of the courtyard. The house and all the pits encircled the courtyard.

The principal layer 1 feature in square 4 was pit 4 with its aligned central postholes. Part of the edge of the terrace scarp was also in this square.

Downslope from pit 2 and dug into Rangitoto ash (layer 2) were several *haangi* and fire pits. These were filled with layer 3 material, mostly Rangitoto ash, stones, charcoal and some midden. Then a similar material, layer 4, appeared with the same type of inclusions but with the Rangitoto ash more mixed with other soils. This area appeared to be the cooking area for the first occupation. It was eventually covered by layer 6 material.

Pit 5 was probably dug a little later when features associated with the first occupation were modified. The size of posthole 5 suggests that a large single post held up a structure, such as a small high storehouse *(whata)*. As pit 5 was shallow and small (1.5 x 1 m), it may have been used for a storage hut, or the posts could have carried a drying or storage rack. The sinking of the pit into the clay and a small gap in the east wall by posthole 5 would allow water from any structure to drain away east rather than flow over the low bank and into the corner of pit 2.

Feature 3, square 3 did not seem to have any obvious purpose. The cut back into the bank at the west side of the basin may have been some sort of drainage channel which would direct water from the bank into the clay depression. It was very shallow but any rain would come directly down the bank to fill it. It would hold enough water for drinking, being 60 cm in diameter and about 10 cm deep, but would soon dry out in the summer.

Pits 1 and 3, previously described (Leahy 1970, pp. 63 and 65), were shallow. Neither was fully excavated. Both appeared near the edges of the terrace. Their function is unknown. Pit 1 was aligned with the house in a north-south direction. Pit 3 was aligned with pits 2, 4 and 5, in an east-west direction.

No artifacts were found in direct association with the first occupation during the 1970/71 excavation, although some were found in the previous excavation. The initial stage of the first occupation reflects a living and storage function with little evidence for a working area, apart from the cache of adzes and roughouts found by the edge of the house (Leahy 1970, p.71).

The alteration to the arrangement of the postholes associated with the house structure without any obvious abandonment for a length of time suggests that in some way the house was unsatisfactory and that some changes were necessary.

Differences also appear between the postholes in the pits and those in the house. All the main house posts were stepped, usually with a squarish or oval outline. One isolated posthole in square 3 (posthole 2) was similar to those in the house. The majority of holes in the pits were unstepped rounded ones. Posthole 2 in pit 5 was an exception but as this formed part of the bank edge of the pit it may have required extra support.

Differences between pits 2 and 4 in the depth of the postholes and the presence or absence of drains seemed significant. Allowing that excavation of a posthole presents problems in establishing its real depth, the holes in pit 4 were generally deeper than those in pit 2. Dimensions are given in Table 5.

Table 5. Dimensions of postholes, pits 2 and 4, N38/30.

	POSTHOLE	Depth (cm)	Width (cm)
Pit 2	—	22	16
	—	20	15
Pit 4	1a	40	16
	2	39	14
	3	27	20
	4	16	14
	5	19	16
	6	29	16

The width of the holes averaged about 15 cm across. The increased depth might have been required to support a more substantial structure, possibly a stronger roof that was more waterproof so that a floor drain was not necessary.

Posthole arrangement, depth and the presence or absence of drains in the two contemporary pits suggest a different function for each pit. One could have been for more perishable goods and one for things needing less protection.

Layer 6, representing the next main stage in occupation, built up over the initial occupation and filled its features. This layer was found in the pits covering layers 1 and 5 without any suggestion of natural infilling, and its buildup must have begun soon after the first occupation, possibly as a continuation of it. Thus the same group of people rebuilt structures further up the ridge and used the old terrace as a stone working and *haangi* area.

The 1970-71 excavation produced practically nothing in the way of flakes or artifacts from layer 6, although the previous excavation had yielded several adzes, roughouts, hammerstones and flakes from the same layer. It would seem that only the west part of the terrace was used as a working area. The eastern side of the terrace at this time seems to have been used as a cooking area. Several *haangi* were found in layer 4, square 6, and cooking activity was also associated with the irregular clay bank in square 3. Similar midden material was associated with layer 6 in both the recent and earlier excavations.

A final more restricted occupation was indicated by layer 7 firepits dug into the surface of layer 6, mainly in the top of the fill in pits 2 and 4. After this the site was finally abandoned.

Conclusions

The excavation at N38/30 took place at the end of a gently sloping spur that ran from the higher central ridge of Motutapu Island southwards towards Station Bay. The terrace was part of an extensive site on the spur which also included pits, terraces and level areas. Often these are marked only by "crop marks" in the grass which suggest alterations to the subsoil at some time.

The terrace examined was dug with the basic idea of forming an area large enough to hold a house, two pits and a courtyard. The builders therefore had to allow enough flat surface for these structures and no doubt had a preconceived idea of the site and the positions of intended structures before levelling commenced.

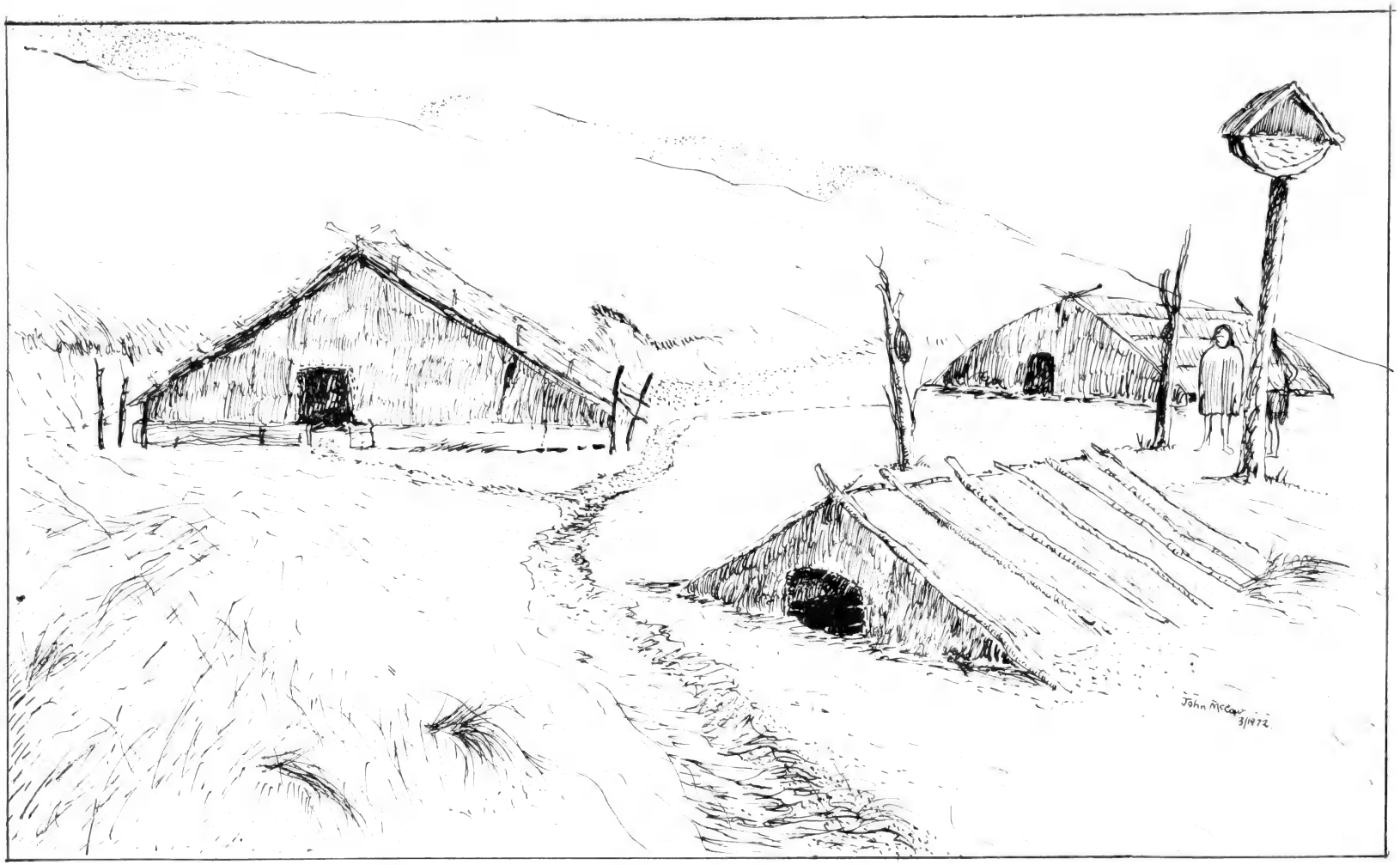

Fig. 6. Artist's impression of the original occupation, seen from the south-east

Other features along the spur suggest that the terrace was only one part of a larger complex of occupation although further excavation would be needed to establish whether the other features were contemporaneous with the excavated terrace.

Pits and flat areas may indicate garden plots and storage of crops. The tops of spurs and ridges would be the most suitable gardening land as the ridges fall away steeply in most cases to streams, swamps or beaches, especially in the Station Bay area. The island has a number of elongated terraces along the sides of some of the ridges and it would be interesting to know if these were used for agriculture because of their sheltered position or because of the need for more gardening areas than the top of the ridges would supply.

Figure 6 is an artist's impression of the terrace, seen from the south-east, as it may have looked, based on the original occupation ground plan (Fig. 3). The drawing is based on Augustus Earle's drawings and paintings especially his water colour of the residence of "Shulitea", Kororareka (Murray-Oliver, 1968, p. 69).

There is little evidence to suggest that activities other than living and storage were carried out on this terrace at the time of the initial occupation. However, a few flakes and the cache of adzes suggest that they were carried out elsewhere.

The second stage in occupation, associated with layer 6, changed the character of the terrace to a stone working and general activity area, with one section devoted to cooking. As no dwellings were established in this layer, they must have been on another part of the site.

The lack of soil build up between the initial occupation (layers 1 to 5) and the subsequent stage (layer 6) suggests that there was considerable activity over a short period of time in this part of the spur and several changes in living patterns. Seasonal activities may have been involved. Another possibility is the development of agriculture in the area, in which case the heavy deposit of black soil in layer 6 may have been the result of increased soil working nearby, up the slope.

Acknowledgements. I would like to thank the following people for their assistance on the site: Lidia Byatt, Andrew Bell, Brigid Pike, Dave Faucett and Hugh McGuire; and Janet Davidson for her help and advice both during the excavation and subsequently in discussions, and for suggestions in the preparation of this report. John McCaw prepared the artist's impression of the site and A. B. Stephenson, R. J. Scarlett and B. P. Kohn identified the fish bone, bird bone and pumice, respectively.

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EXCAVATION OF A PIT AT SITE N38/25, STATION BAY, MOTUTAPU ISLAND

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Abstract. Site N38/25B is a group of pits on a ridge at Station Bay, Motutapu Island. It is separated by a defensive ditch from the main area of N38/25, and is probably associated with a pre-ditch occupation of the rest of the site. Evidence recovered from excavation of the largest pit was consistent with its use for storage, and some continuity of use was shown by small oval pits dug into its floor. Several periods of occupation were indicated by adjacent external structures. Copious plant remains, chiefly in the form of charcoal, included some prepared fibres. Fire-reddened clay may indicate a local "make-do" source of red ochre.

TOPOGRAPHY AND SITE DESCRIPTION

Site N38/25 is situated on the crest of a long narrow ridge which runs down in a southerly direction from a higher and wider ridge. The subsidiary ridge runs out into the sea to form the east side of Station Bay in the north-east coastline of Motutapu Island (Fig. 1; Davidson this volume, Fig. 1). Site N38/25 was originally recorded as a headland pa with adjacent pits (Davidson 1970a, Fig. 1 and p. 5). The profile of the northern part of the site is concave with a massive ditch extending across the lowest point. Just to the north of the ditch are the pits with which this report is concerned. They are designated as site N38/25B.

Fig. 1. General view of site N38/25 from the north, with Station Bay on the right. The two small pohutukawa trees in the centre are growing out of the northern ditch, with N38/25B directly in front.

In this area, the ridge top is about 30 m above sea level and between 9 and 12 m wide, with its surface dipping gently to the south-west. On the east of N38/25B there is a steep drop to the sea. This begins with an abrupt grassed descent to a spread of bare rock which is angled back at 60 degrees and difficult to climb. At the base of the cliff there is a narrow shore platform, covered at high tide. On the west side of the ridge facing the bay, below N38/25B, the upper surface merges into the downward slope to the bay beach, at an angle which is quite gradual at first, and everywhere less steep than on the east side. Slopes are grass-covered all the way down to a wider shore platform, and at this point also the side of the ridge begins to swing out to the west around the head of Station Bay.

On the ridge top, three pits were initially visible as surface depressions, roughly in line with each other in the middle of the ridge, with rectangular outlines, and with long axes at right angles to the long axis of the ridge.

The uppermost pit, D, (Fig. 2), is *ca.* 5 x 3 m and over 0.5 m deep measured from the lowest edge. It is *ca.* 6 m away from the next pit, C, which is roughly the same depth, but smaller (4 x 3 m). Pit C is *ca.* 4 m from the excavated pit B, the largest of the group, with an unexcavated outline of *ca.* 8 x 5 m. All three pits have

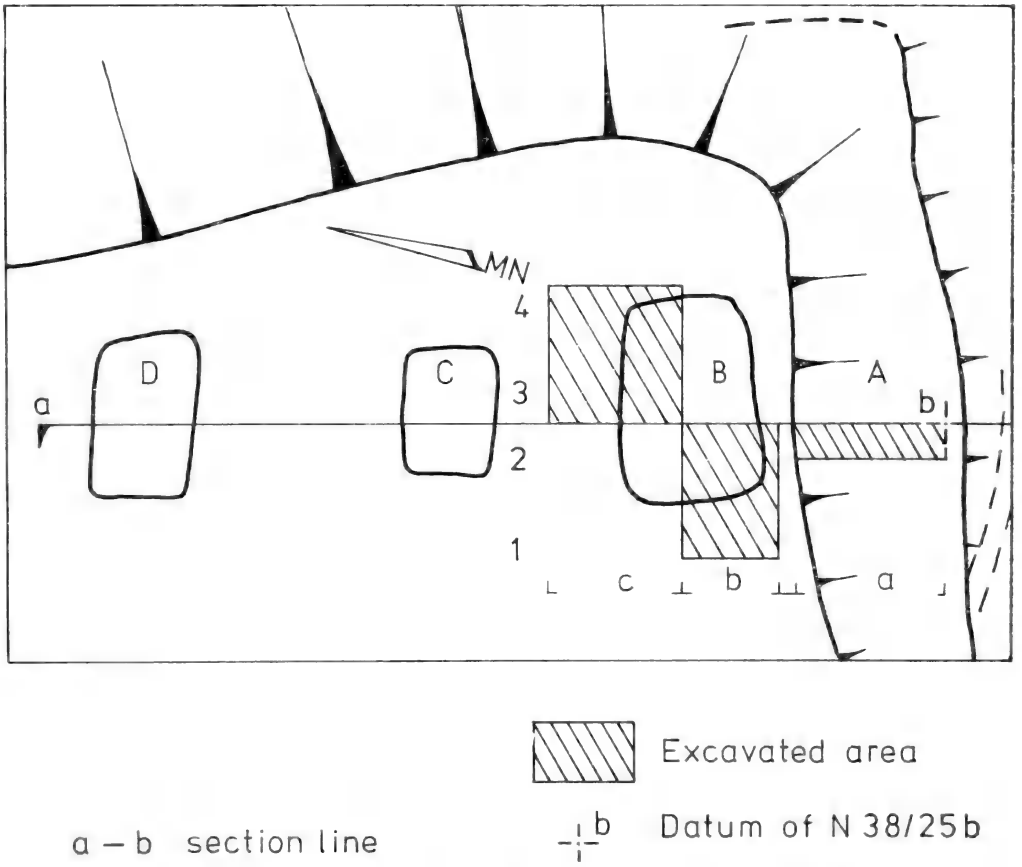


Fig. 2. Plan of site N38/25B, showing excavated area. Scale: section line a-b represents 25 m.

high back or upridge walls, which form a series of stepped scarps down the ridge (Davidson this volume, Fig. 1). This is most marked in pits D and B, where the back walls approach 2 m in height, and less so in pit C, where the drop is *ca.* 1 m. In the lowest pit, B, the front or downslope wall also forms part of a scarp with a drop of 1 m. This scarp extends right across the ridge top at this point, and marks the boundary of a narrow flat area below pit B, called in Figure 2, area A. Area A also runs right across the ridge top on the lip of the northern ditch. In opposition to the general tendency of the upper surface of the ridge which dips south-west, this area dips gently to the east. It is about 5 m wide at its central point, and is cut off by the sharply descending north wall of the northern defensive ditch.

There are several directions of approach to the pit area; firstly from the direction of the pa by paths zig-zagging down and up the sides of the ditch; secondly from the north along the seaward side of the ridge. A third approach runs round the head of Station Bay at shore level, along the pebble beach, and then across the shore platform to the grassed west side of the ridge where a diagonal path leads by a moderately steep climb to the lower end of the pit area. The fourth and easiest approach is from the north again, down the moderate slope from the higher ridge, which itself leads north-west to join the main ridge system of the island.

Vegetation

The ground surface in the vicinity of N38/25B is, like that of the rest of the island, covered with introduced pasture grasses. However, a few resilient indigenous species, possible relics of pre - European plant communities, maintain a hold. In the immediate vicinity of the site, two youngish pohutukawa trees (*Metrosideros excelsa,* Gaertn.) have established themselves on the weathered north wall of the ditch, and there are others on the sea cliff on the east side of the ridge, and one or two on the slopes to the west. Bushes of the smaller species of *Phormium* (*P. cookianum,* Le Jolis) are similarly distributed, being relatively numerous on small ledges in steep areas of the sea cliffs, but seen only as occasional isolated individuals on the west side of the ridge. No specimens of *Phormium tenax* were seen in the neighbourhood of the site. Further down the ridge there are very steep bare slopes just below the summit area of the pa on the east side, and these support a number of small scrubby patches of bracken, *Pteridium aquilinum* var. *esculentum.* No Cordylines or tree ferns were seen anywhere in the vicinity, the nearest and only observed tree fern being at Home Bay, two and a half miles away.

Aspect

Motutapu Island shares with the Hauraki Gulf generally a fairly equable climate without any great extremes of winter cold or summer heat. Storms are not particularly frequent, and Station Bay is generally sheltered except in an easterly storm. The ridge sites, however, are in a rather exposed situation, being exposed to the full force of winds from three quarters, and only partly protected against those from the north. During the period of the excavation, (summer, 1970 - 71), days generally began with air on the ridge quite calm, but wind strength mounted, and at evening was usually moderate to strong. Air temperatures were warm, however, and the situation good if shelter from the wind was obtainable.

GEOLOGY

Throughout the northern two - thirds of Motutapu, the geology of which has been the subject of detailed study by W. Mayer (1965), strata are chiefly greywackes and argillites, of Mesozoic, probably Jurassic age, and have been folded tilted, faulted and jointed. Strata in the immediate vicinity of Station Bay mapped by Mayer (1965, Fig. B), follow the general north - westerly strike of the Mesozoic on Motutapu, which is roughly parallel to the trend of the east headland ridge which contains site N38/25. On the ridge itself there is some displacement of strike further round towards the west. To the north - east of Station Bay, Mayer has mapped an anticline (1965, Fig. C), which closes in a direction slightly west of south, and the line of the east coast of the ridge is a rough approximation of the line of continuation of the fold axis in the direction of plunge. To the west of this line, strata are dipping westward at large angles, being stacked on edge in a position approaching the vertical.

Down the long west side of Station Bay there is a shoreside strip of outcropping cherts and volcanic argillites. East of this, as far as the mouth of the small stream at the east end of the pebble beach at the head of the bay, strata consist of argillites in the basement rocks. To the east of this stream, and continuing roughly to the point where the beach track begins to climb up the ridge side to the pit area of N38/25B, there is a sequence of interbedded greywackes and argillites. These outcrop on the shore platform just west of the ridge, where they show predominantly green, blue and grey colours. These beach outcrops show minor faulting and are closely jointed; and joint, fault and bedding surfaces are heavily mineralised, chiefly with limonite.

On the ridge itself, strata once more consist of argillites, and on the outcrops on the shore platform surrounding the headland, the same pattern of mineralisation of surfaces was observed. On the top and sides of the ridge, the argillite substrate, except on the exposed eastern cliff area, has weathered to light coloured clays, streaked with mosaic patterns of weathered joint materials.

This clay is exposed in pockets of slumping on the western slopes, and in the ditch cut across the ridge top. Elsewhere it is covered by topsoil which is underlain in places by patches of weathered volcanic ash of recent origin.

In the course of excavation, a bedding plane between argillite strata was found to run across pit B, roughly parallel to the east wall and about 1 m west of it. The bed to the east of this plane was marked by a rather uniformly weathered pale yellow clay, while the bed on the west had weathered to a pale greyish white, with rust-coloured weathered joint fillings. This bed appeared to extend across pit B, and in it soft, moderately decomposed rock at 1.3 m below the present ground surface showed a green colour similar to that of many of the beach outcrops. A second bedding plane marking off a third bed, although not seen, evidently ran just beyond the west edge of pit B, as clay at some depth just beyond this was a brown yellow colour.

THE EXCAVATION

Site N38/25B was excavated concurrently with excavations on other areas of N38/25, under the overall direction of Janet Davidson, of the Auckland Institute

and Museum, by members of the University of Auckland Archaeological Society, between December 19, 1970, and January 26, 1971. A grid of quadrates was laid out from a datum point (b on Fig. 2), sited at the south-east corner of a quadrate in area A. Quadrates B1, B2, C3 and C4 were excavated, covering about half the area of pit B and some adjacent ground. These were all 2 m wide; in row B they were 3 m long, and in row C, 4 m. A 50 cm wide baulk was left between B2 and the quadrate in area A. Baulks were not left elsewhere except for a couple of small pillar baulks on the west edge of pit B, straddling the boundary B2 and B1, to record stratigraphy against the pit wall. One of these is seen in Fig. 5 (top right), and both were later removed. Excavation was largely by hand trowel, and proceeded at an average rate of 0.06 m per day in depth. Total depth of deposits removed varied from 0.05 to 1.30 m, with a total volume of about 9 m^3. Excavated material was not sieved. Approximately 0.45 m^3 of material excavated was retained.

Excavation of four quadrates, B1, B2, C3 and C4, combined with information derived from the excavation of the strip across area A (Davidson, pers. comm.), showed more complexity of occupation than appeared on the surface (Figs. 3 and 5), and indicated several separate periods of use for the area. The most recent structural alteration was apparently to area A, and this itself seems to have preceded the cutting of the ditch on its south side in connection with the defences of the pa.

Pit B was initially dug as a large (5 x 3 m), flat-floored pit (Fig. 3), about 1 m deep, with three median rows of postholes. At least three small pits with shallow rounded bases were later dug into the floor between the roof supports, and then filled in. Two associated structures were also revealed outside the perimeter of pit B. Pit E is a narrow shallow pit, with a small buttress, on the north - east of pit B, which appears just to postdate the period of use of pit B. Structure W on the west of pit B is possibly a terrace, and appears to predate it considerably. All three structures, B, E and W, are in alignment, with sides parallel, suggesting that later structures were placed with some reference to earlier ones.

Structure W

The earliest activity is represented by structure W, only part of which fell within the excavated area. As partly seen in excavation, W has two approximately straight sides meeting in a right angle (Figs. 3 and 5). One side, 2 m long, is parallel with the west edge of pit B, from which it is separated by a baulk about 2 m thick at the base. The top of this baulk is curved, the top of the curve being just below the present ground surface. The short side of W, only about 30 cm long in the excavated area, runs west, and seems to be quite short, as the ridge top drops away on the edge of the excavated area (Fig. 4).

The walls of W are 60 to 70 cm deep, and are slightly beyond the vertical at the top, where they have been pushed by lateral pressure from the baulk. Structure W faces the south - west and has a floor which slopes gently down in this direction. Floor and walls are cut into a brown-yellow clay, which is deeply cracked into large shrinkage polygons, with cracks penetrating more than 20 cm. In the south - west corner of the floor, there is a deep structural crack in the clay, about 4 cm wide and possibly more than 1 m deep. As the clay of the walls and floor was moist when excavated, and the depth of cover at the base was about 1 m

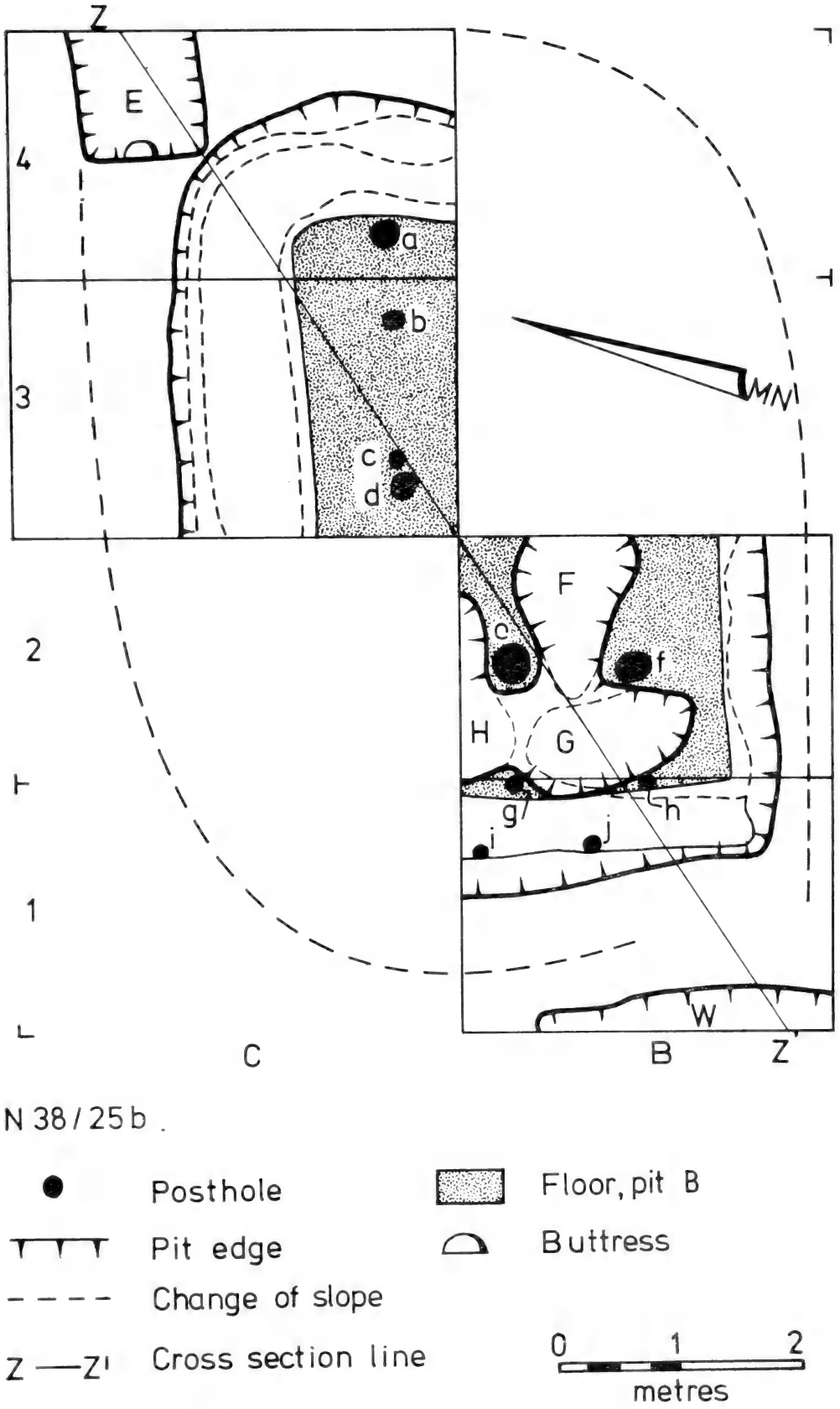


Fig. 3. N38/25B. Structural features of quadrates B1 to C4.

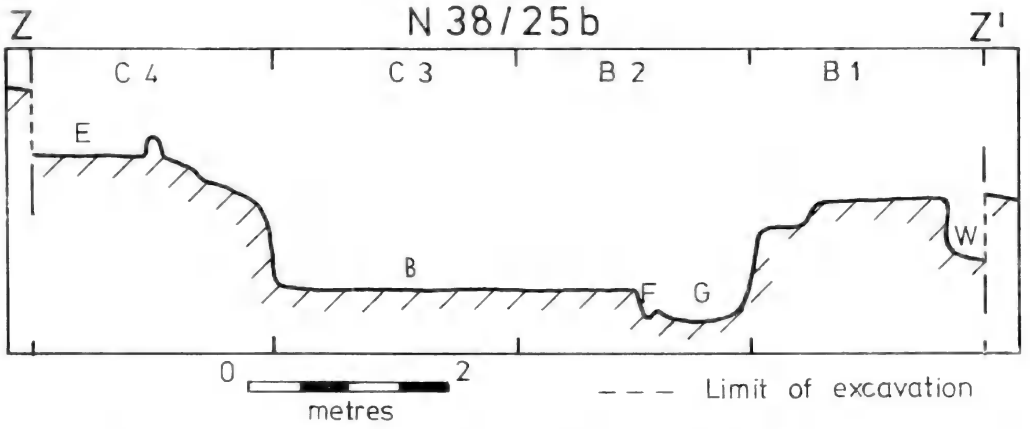


Fig. 4. N38/25B. Cross-section, Z-Z' (see Fig. 3), of quadrates C4 to B1, showing relative heights of excavated structures.

from the ground surface, this cracking cannot be explained as normal present day shrinkage, such as is seen in the clay of the rim areas of pit B (Fig. 5), where the surface clay has been split to a depth of a few centimetres under a thin cover of topsoil. The severe cracking in W appears to record a period when walls and floors were subject to prolonged direct exposure to the sun's heat, inducing deep shrinkage and cracking which its subsequent history failed to remove.

The lower two thirds of deposits in W seem to have formed by natural means, and contain no cultural material. Resting directly on the cracked floor are small patches of rubble, ("rubble" being used here of weathered fragments of argillaceous rock which still keep an angular outline and some stony hardness). Over these is a thick layer of alternating deposits of two types of material, the most frequent being a blackish fine silty material which seems to be weathered Rangitoto ash. Between the black layers are thin lenses of yellow clay-derived material. The black layers seem to have been brought in mainly by the wind, and the yellow lenses possibly by heavy rain from exposed clay areas higher up the ridge.

Structure W is clearly of artificial origin, but just what it is, is less clear. It might perhaps have been a pit, but with the ground sloping away immediately below, there is hardly room for two more walls, though it could be argued that these might have been eroded or artificially removed. Another possibility, and perhaps a more economical one, is that it is a small terrace facing south - west. This aspect, which would ensure maximum exposure to summer sunlight, is consistent with the evidence of prolonged drying in the cracked clay walls.

After it became disused, the probable terrace was gradually covered with windblown and rainwashed material. There is a time gap between the disuse of W and the digging of pit B. Ash deposits were found only in structure W and in a few small thin patches in pit B close to its south - west corner, where they had clearly originated from W. No trace of ash was met with in the stratigraphy of either modified or unmodified areas in quadrates C3 and C4, or in area A. Thus, the only immediate source of ash was W, making it clear that this structure must have been dug, used, and then partly at least covered with ash before pit B was in use. Thin streaks of ash are found in the south - west corner of pit B from the lowest levels

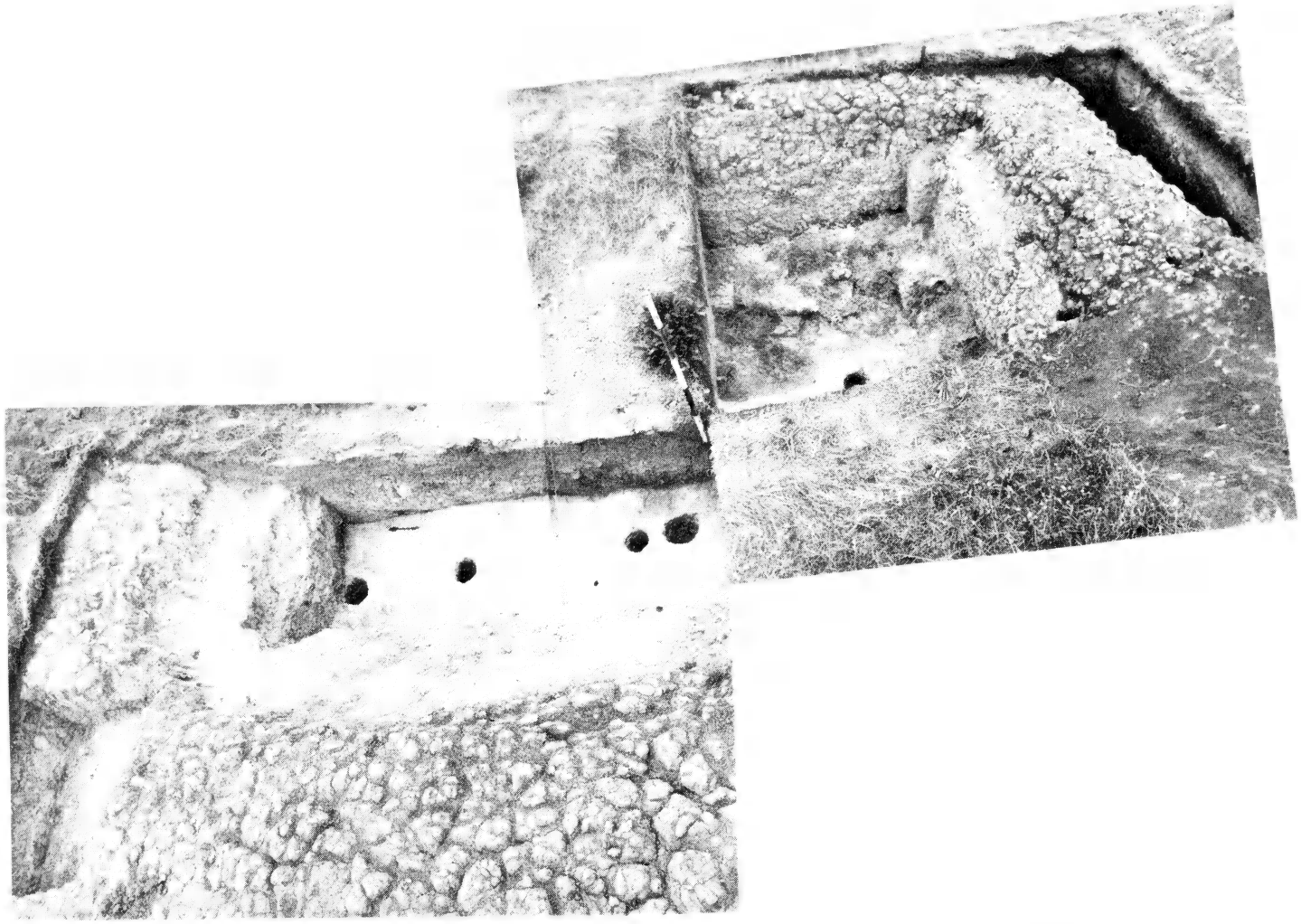


Fig. 5. N38/25B. Composite view from north of quadrates C4 (on left) to B1 (upper right) showing excavated areas. Left, pit E; centre, pit B, with ledge and baulk on right; top right, structure W. Charcoal layer 10 removed in quadrates C3 and C4 from floor of pit B, but still covering floor in quadrate B2.

to almost the last deposit before the formation of the modern topsoil. If ash was still being wind carried over some distance during the short period when pit B was in use, it was probably still in movement for a time afterwards and it is surprising that there is no thicker and more extensive layer of ash in the fill of pit B which would be a natural collecting point. It seems probable, therefore, that ash deposition in W had ceased an unknown length of time before the construction of pit B.

As the west wall of pit B is parallel with the east wall of W, and less than 2 m away from it, it seems certain that the edges of W were still perceptible when pit B was dug. W would be seen as a patch of soft ash, sloping down the side of the ridge, and marking an area which would be useless for the purpose of digging a storage pit, and therefore to be avoided. Thus, the baulk, and the west wall of pit B run parallel to this area of dead ground, but far enough away to give the pit wall adequate support and insulation. The west wall of pit B has a narrow ledge (about 50 cm wide) cut right along its lip (Fig. 5), at a level running 20 to 40 cm below the edge of the baulk. This rather unexpected feature had a structural function in the pit, but may have originated simply as a line for the west wall of pit B, marked out and dug to a shallow depth and then abandoned, because it was felt to be too close to the soft ash of W (Fig. 4), and a new line marked out a foot further back to the east.

At some time after the accumulation of ashy deposits over W, and also after the cutting of pit B, the site of W was used as a dump for material excavated or shifted somewhere in the vicinity (Fig. 6). This dump is made up of a number of different layers and lenses of material; light brown soil (layer 21); yellow clay lumps (layer 20); and several mixed layers. The top layers 21 and 20 spill down towards pit B, thin out or disappear over the top of the baulk, which appears to have been a footpath down the ridge, and reappear in pit B, fanning out from the south - west corner along the west wall. The various layers of the dump seem to represent a single unit, so it seems fairly clear that the episode of earthworking recorded by the dump does not relate to the cutting of pit B, but to an activity considerably after the abandonment of pit B.

STRATIGRAPHY OF FILL LAYERS (Fig. 6)

Layers are described from the base upwards. Layers denoted by numbers correspond to layers in pit B to which they are similar or identical.

Layer 1. Weathered and severely cracked clay natural of walls and floor, here a brownish yellow colour.

Layer a. Discontinuous patches of small pieces of white rock rubble.

Layer b. A thick deposit of a mixed character, 50-60 cm deep, containing a large number of lenses, including lenses of black powdery ash up to 5 cm thick, alternating with similar brown lenses, which appeared to be black ash, mixed with very fine particles of yellow clay, and clean thin lenses of soft yellow clay earth. This whole set of deposits had a soft floury character, and reacted like flour when a load of heavy material was dumped on top of it, by partial collapse, and by upward slippage around the edges of the heavy layers. This distortion and displacement was clearly seen in the section and indicated that the dump material on top was in fact dumped with some force.

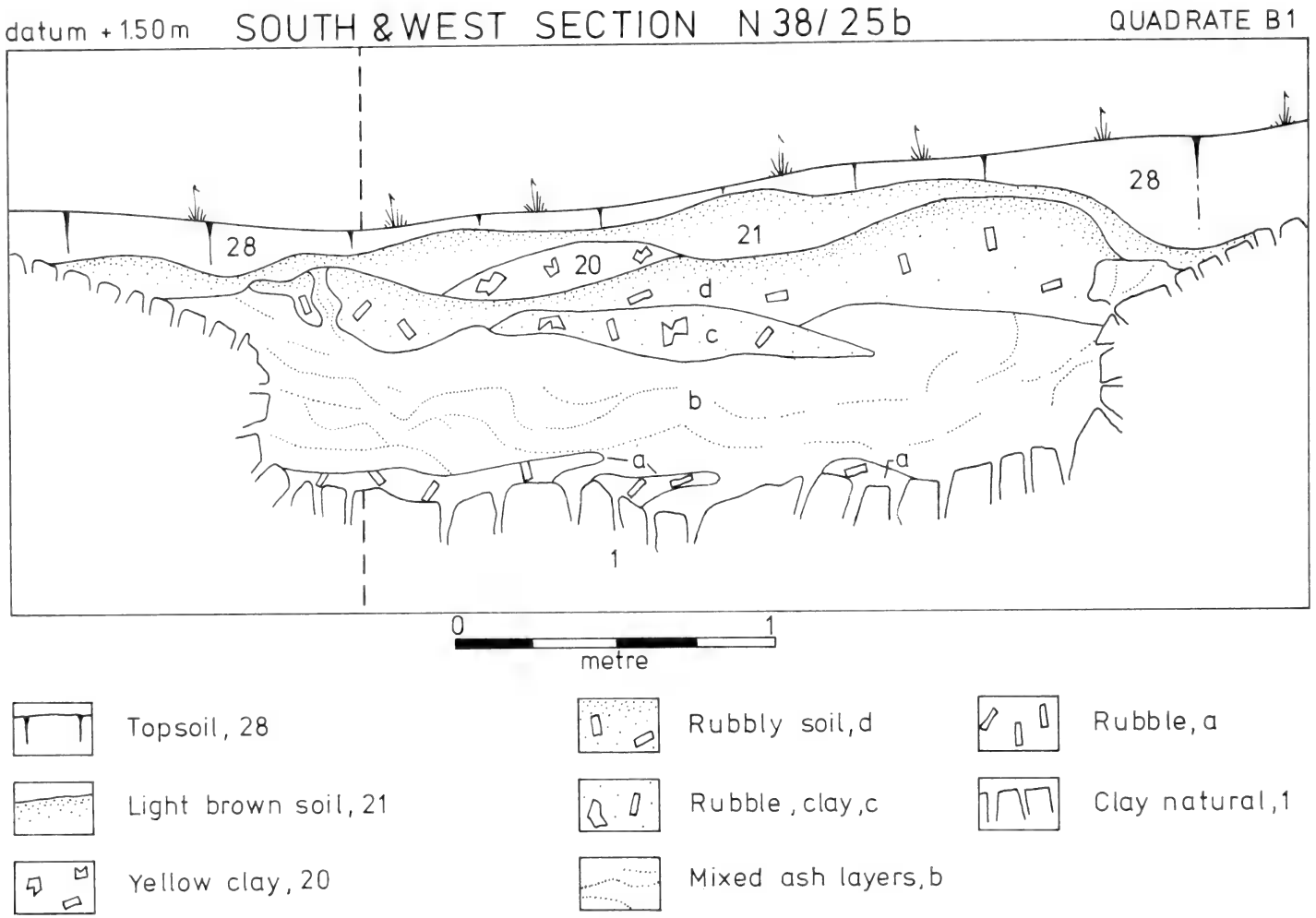


Fig. 6. N38/25B. Stratigraphy of fill layers, structure W.

Layer c. A lens of large pieces of yellowish grey rubble, with smallish to medium yellow clay lumps, and yellow clay soil. Much of this material showed caked dried rain-wash surfaces, towards the base of the layer, identical with crusts which formed on this material on the excavation spoil heap when it dried out after heavy rain.

Layer d. A thick layer of yellow clay soil, with small orange chips of rock rubble, and some clumps of hard yellow clay lumps, up to 20 cm long.

Layer 20. A lens of thick lumps of hard yellow clay averaging 15 cm in diameter. This lens petered out over the baulk and reappeared below the edge of pit B, where the identical nature of the lumps, and the relation of the layer to the overlying layer 21, make it clear that these are the same deposit.

Layer 21. A deposit of light grey brown soil, with small (0.5 cm) light grey to whitish rubble chips which gave the layer a finely angular character, though the soil had some tendency to a crumb structure and crumbled to a fine powder similar to Rangitoto ash. The continuation of layer 21 across the baulk into pit B was very thin but quite clear, and the layers were identical in both places.

Layer 28. Layer 28 was the universally present modern black topsoil which had Rangitoto ash as a basic constituent, a fine crumb structure, and apparently plentiful humic content. Layer 28 was very thin in the centre of the section over what appeared to be the peak of the dump pile, which is probably a further indication of the relative recency of this pile.

Pit B

FIRST PERIOD OF ACTIVITY

Pit B was initially cut as a flat-floored pit, taking up a large part of the available space of the width of the ridge top, leaving a narrow passage on the west, and a slightly wider area on the east. The walls of pit B were cut to about 1 m in depth in the south - west corner, with a rim at this height above floor level; walls and rim rising to about 2 m in the north and east.

The north wall and the east wall of the pit, as uncovered, were badly eroded (Fig. 5), and it is impossible to be certain what their configuration originally was; however, it is probable that they were angled back from the vertical to some extent, possibly in several slopes of different angles. It seems relatively unlikely that they were cut sheer, as there is not a sufficient volume of erosional material in the fill of the pit, to represent fully their erosion from a vertical edge to their present conformation.

On the south and west the excavated walls were in good condition, showing a clean, quite smooth clay surface, which sloped very slightly outwards from the base of the pit.

The floor of the pit, as initially cut, appeared almost flat, with a very slight slope from north and south into the centre.

There was no sign of any kind of drain cut into the floor of pit B, and although, because of later disturbances to part of this flat floor, it is impossible

to say with certainty that no drains existed, it is very likely that there were no regular drains, as there were almost certainly none just a little later.

Parts of three equally spaced rows of postholes were excavated. (Fig. 3), an approximately central row running west to east, and two side rows, each about 1 m away from the central row. Two small postholes, (g and h, Fig. 3), were excavated against the west wall, and a large one, (a), against the east wall, but there was no trace of a line of postholes against either the south or north walls.

Postholes in the left hand row in Fig. 3 had depths of 25 cm (a), 45 cm (b); 28 cm (c); and 30 cm (d). Posthole h was 45 cm deep. Postholes e, f and g were not fully excavated.

In the three rows on the floor of pit B, postholes were in line, both lengthways and crossways, but two small holes set in the top of the ledge against the side of the baulk in quadrate B1 (i and j, in Fig. 3, with depths respectively of 10 and 5 cm) are out of alignment with these rows.

A small posthole, c, and a large one, d, close together in quadrate C3, show that roof supports were replaced at least once; this indication of repair and re-use of the pit after one season is borne out by other evidence. The small posthole, c, was the original one, with a fill which included small yellow clay lumps, very small pieces of charcoal, and small pieces of burnt clay. The larger replacement posthole, d, had a soft brown earthy fill, which consisted partly of decomposed woody material, apparently the rotted remains of a post butt, and postholes a, b and h had a similar decomposed woody fill to that of d. Posthole g contained a brown woody fill also. The top 20 cm of postholes e and f contained a burnt red earth fill. Below this, the fill appeared in both to be the same brown earthy and woody fill as in most of the other postholes.

As previously mentioned it is probable that no drains were cut in the floor when the pit was first constructed. This suggests that other arrangements were made for storm water drainage. One possibility is that the roof was maintained in a strongly watertight condition during the periods when it was in use.

The very large posthole e, in the central row, suggests the existence of several others of the same size in the unexcavated quadrates B3 and B4, and implies the use of a sturdy central ridge pole, probably made in several sections. This would indicate an eaved roof, with additional support provided for subsidiary battens and rafters by the two flanking rows of posts.

It is probable, in the exposed windy conditions of the ridge top, that a roof which was low in relation to the overall height of the surrounding ground would have several advantages; in lessening wind resistance by the structure, and decreasing the amount of maintenance necessary for the roof; in improving the insulating qualities of the structure, and in making the roof easily accessible from the ground for necessary repairs.

The three post rows in the centre of this pit appear to have been designed as the main structural elements of the roof. This is suggested by the apparent absence of any remains of structural supports round the sides and rim of the pit in the

south - west corner which appears to be in very good condition. There were likewise no post or slot holes on the high north side and probably on the east side. Though there has been erosion on these faces, it is likely that it was confined to a zone less than 30 cm wide, and the absence of post or stake holes here may be tentatively taken as original.

With three central rows of supports and no signs of any others, it is possible that the raftered ends of the roof rested on or close to the ground on the north and south sides, with low gable ends on east and west. The two anomalous shallow holes in the ledge may be the remains of a light gable end framework, though j is probably, and i may be, an accidental feature. (They were both filled with layer 21 material.)

To keep the pit dry it would be necessary to ensure that rain water did not pour in, especially from the north, and the most economical roof in all the circumstances would have been a pitched roof with a height of about 3 m or less from the pit floor and an unequal pitch on its two halves – i.e. a very gentle slope from the roof ridge to the upper ground surface above the north wall; with the ridge perhaps 30 cm above this surface, and the roof resting on the ground a little beyond the wall. In this case the row of posts on the north side would have to be almost as long as the central posts and it is significant that it is a post in this row which shows signs of replacement.

On the south side of the roof, there would be a more sharply angled pitch on to the lower ground at the south end, but the entire roof would not protrude more than half a metre above the general slope of the ridge, and would offer negligible resistance to the wind.

It seems likely from the arrangement of posts in the floor, that the main function of the pit was storage. It could have been used for sleeping, but was not conveniently arranged for this. Also it shows no signs of the repeated foot traffic in and out which would be expected from a shelter in daily use, whereas a store would be expected to show less sign of wear.

The natural entry point to the pit is at the south - west corner, and the height of the walls makes it improbable that there is any other entrance in the unexcavated parts of the pit. The south - west corner is the lowest point on the rim and there are several indications that it was used as an access way. Firstly, the surface of the pit rim at this point is slightly but definitely flattened over about a metre; then the existence of the ledge along the west edge of the pit provides a threshold, and the surface of the ledge has been compacted in the south - west corner.

Entry down into the pit from the ledge would have been by ladder. When the small pillar baulk shown in Fig. 5 just below the ledge in the south - west corner of the pit was removed, there was a slot in the corner of the wall, an indentation in the clay about 30 cm below the surface of the ledge, which was 20 cm long and 8 cm deep, and could have provided support for a wooden ladder of the solid timber variety. Also when the floor pits began to be dug, the area of flat floor directly in line with this, at the point where a ladder would touch the floor, was left intact (Fig. 7).

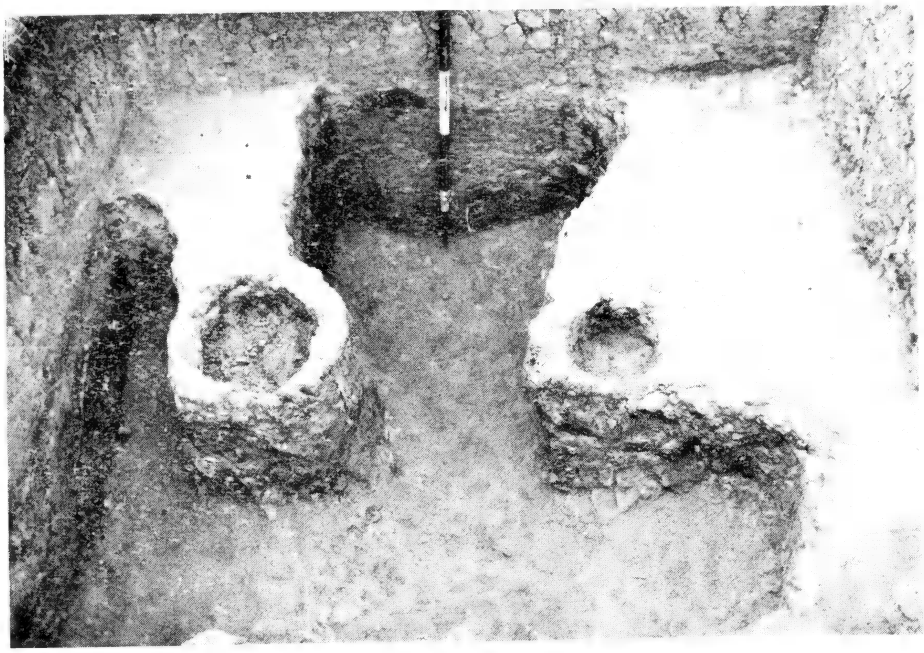


Fig. 7. N38/25B. Quadrate E2 from the west, with small pits cut into floor of pit B between postholes e (left) and f (right). Pit H (left), pit G (foreground), pit F (background). Shallow divisions between pits H/G (left centre), and G/F (centre).

SECOND PERIOD OF ACTIVITY: FLOOR PITS

It is not certain how long the original unmodified flat-floored pit was in use, though as remaining parts of this floor show little or no build up of deposits from this period, it was probably for a short time, perhaps not more than one season.

After this period, and while the roof was still in position and in good repair (the replaced post probably dates from this period), a number of small, roughly oval pits were dug into the flat floor between the roof supports; with great care taken not to weaken the roof posts to the point of collapse. These pits, F, G, and H, (Figs. 3 and 7), were excavated only in quadrate B2, but extend into quadrates C2 and B3 at least (Fig. 3).

The sides of each pit were vertical, being cut into the weathered green coloured rock natural of pit B. The edges, though rough, were clean, and though fill in each pit was packed tight, the edges were clearly marked by a rusty brown stain from groundwater which had trickled down between the edge of the pit and the edge of the fill.

Pit G is a semi-ovoid with its large end skirting two postholes of the central row; its small end edging in between, and a little beyond, the two corresponding postholes of the south row, and coming quite close to the south wall of pit B; and its west side bellying out to scrape the west wall of pit B. Pit F shows what is obviously part of the same standard plan, with a narrow neck inching up to postholes e, and f, swelling out in the space between post rows, and showing signs of terminating at the top in the area of quadrate B3. Pit F is set at right angles to

pit G, as is also pit H, which shows conformity to the same basic egg-shaped plan, with a narrowish neck, bulbous side, and wider base.

Pit G is about 1 m wide and 1.5 m long, and this seems to be a roughly standard dimension, as pit H is about this length, and pit F about this width. Pit F, which is set largely in an unrestricted area between postholes, could have been a lot wider than 1 m, had it been desired.

Each pit was the same depth, about 60 cm at the deepest part of a gently and shallowly rounded base, which sloped down about 10 cm into these central hollows. As uncovered by excavation, with the removal of fill from each, these pits opened into one another, and it is probable that after the initial pit was dug, one pit was dug from the unfilled hollow of another. Shallow lips or divisions (Figs. 4 and 7), about 10 cm high, separated pit F from pit G and pit G from pit H, and in each case these completed the shallow saucer shape of the pit floor.

It is clear, from the care taken to dig around postholes, that the roof was still in commission at this time, and it is also clear from this that no more than one of pits F, G, or H can have been open on the surface of the floor of pit B at any one time. With only one pit open, no more than one quarter of the circumference of any one posthole would have been exposed without support at a time, and this apparently did not weaken any individual post beyond usefulness. The large posthole, e, in the central row in quadrate B2 has been exposed on three sides by successive pits, apart from a very narrow rim, and the only solid material left in position around it is a long thin neck on the east. Any post in this hole would have collapsed in the next wind if F, G and H were all open together.

The question of the order of digging of particular pits proved rather complex, and only tentative conclusions are offered. The fill in each pit clearly formed a separate unit, but each unit had wobbly but overall straight boundaries, so that it proved impossible to say that one lot of fill intercut another. However the bases appear to show some signs of intercutting, the base area of pit G seeming to be slightly encroached on by the bases of both pit F and pit H, over the lip areas. This apparent slight crowding of pit G possibly indicates that G was dug before either F or H.

In the base of pits F and G, there is a thin layer, (layer 2a, Fig. 8); this is 1.5 cm thick in G and 0.8 cm thick in F. It appears to consist of material trodden into the floors by bare feet or sandals, after being picked up outside pit B, around the area of N38/25B and tracked in. It consists of quite a lot of Rangitoto ash, of a purple-brown colour suggesting surface weathering, and frequent small particles of charcoal and fire-reddened material, all appearing to have been trodden into a sort of paste.

It is suggested that this material may have been incorporated when each pit was being dug, by people filling containers with the spoil which was being dug from a pit, taking it outside the large pit to dump, and returning for another load. As only F and G contain this layer, which is thicker in G than in F, it is possible that this indicates that the ground surface outside pit B was covered with debris from fires when G was being dug, and that such debris was still lying about in a more scattered state when F was dug, and had possibly been dispersed completely when H was made. Thus it is tentatively suggested that G may have been dug first, followed by F and then by H.

If one assumes in the apparent absence of contradictory evidence, that pit B was a store pit, and that the crop was probably sweet potato, as being the most likely item to require such a large area of insulated storage, then it seems permissible to suppose that pits F, G and H represent repositories for seed kumara.

It seems clear that these pits did not function as sumps for drainage purposes. There were no signs that water had lain in the open base of any one. The thin layer of base fill in F and G was mashed, not graded, and was spread evenly over the curving pit floor, and not as a flat-topped deposit of varying thickness, as would be expected of a water laid layer in the very restricted area of a puddle. The pits then were dry when each was open, which again presupposes an effective roof.

In the case of pit G, it might be argued that the choice of a corner directly below the entrance way as a site for a seed store seems rather a poor one. But this may have been dictated at first by its very closeness to the entrance, through a desire not to encroach on the floor area too much. Also, if the entrance was, as seems likely, a narrow gap between a low pitched roof and the ground, and if this entrance was well blocked when the pit was in use for storage, and visits to it relatively infrequent, then this was probably no real disadvantage.

It is suggested that the curved and depressed central area of the base of each floor pit was designed to support a framework of strong light branches, such as kanuka, *Leptospermum ericoides* (saplings of which are growing at present at the heads of the Station Bay stream valleys on the west of the ridge) on which kits of seed kumara might rest. The curved space under this rack would allow adequate ventilation and prevent the growth of moulds; and the floor pits could have been roofed over with a quantity of tree fern fronds.

Such a depth below the surface of the ground apparently provided good storage conditions as at least two pits similar to the first were dug, though bacterial infection probably forced their abandonment in the end.

Each pit was filled with a different kind of fill, and each lot of fill was probably levelled off flush with the floor of pit B. Pit G, apart from the thin basal layer, was filled entirely with yellow lumps of clay packed hard. Pit F and pit H each contain several layers of fill, one of which in each case appears to be freshly cut greenish rock, similar to the rock in which all three pits are cut; suggesting that in these cases an old pit was partly filled with material which had just been cut from a new pit, and that therefore there is possibly a fourth floor pit in one of the unexcavated quadrates, perhaps in B3.

It is certain that these floor pits were dug and used consecutively and not simultaneously, and it also seems clear from the close replication in pattern seen from one pit to another, and from the fact that they are clustered together and not scattered haphazardly over the floor of pit B, that they were dug at regular, probably annual intervals, and by the same group of people. Pit B, then, was in use for a minimum of three and a possible maximum of five years.

In speculating about the effect of the existence of stored food and seed on the mobility of such a group of people, one would expect that in general, the existence of a store of food would require that its owners would reside close at hand, or close enough at hand to supervise it, until it was used up. In the case of kumara harvested and stored in autumn, this would indicate that there would be autumn

If one assumes in the apparent absence of contradictory evidence, that pit B was a store pit, and that the crop was probably sweet potato, as being the most likely item to require such a large area of insulated storage, then it seems permissible to suppose that pits F, G and H represent repositories for seed kumara.

It seems clear that these pits did not function as sumps for drainage purposes. There were no signs that water had lain in the open base of any one. The thin layer of base fill in F and G was mashed, not graded, and was spread evenly over the curving pit floor, and not as a flat-topped deposit of varying thickness, as would be expected of a water laid layer in the very restricted area of a puddle. The pits then were dry when each was open, which again presupposes an effective roof.

In the case of pit G, it might be argued that the choice of a corner directly below the entrance way as a site for a seed store seems rather a poor one. But this may have been dictated at first by its very closeness to the entrance, through a desire not to encroach on the floor area too much. Also, if the entrance was, as seems likely, a narrow gap between a low pitched roof and the ground, and if this entrance was well blocked when the pit was in use for storage, and visits to it relatively infrequent, then this was probably no real disadvantage.

It is suggested that the curved and depressed central area of the base of each floor pit was designed to support a framework of strong light branches, such as kanuka, *Leptospermum ericoides* (saplings of which are growing at present at the heads of the Station Bay stream valleys on the west of the ridge) on which kits of seed kumara might rest. The curved space under this rack would allow adequate ventilation and prevent the growth of moulds; and the floor pits could have been roofed over with a quantity of tree fern fronds.

Such a depth below the surface of the ground apparently provided good storage conditions as at least two pits similar to the first were dug, though bacterial infection probably forced their abandonment in the end.

Each pit was filled with a different kind of fill, and each lot of fill was probably levelled off flush with the floor of pit B. Pit G, apart from the thin basal layer, was filled entirely with yellow lumps of clay packed hard. Pit F and pit H each contain several layers of fill, one of which in each case appears to be freshly cut greenish rock, similar to the rock in which all three pits are cut; suggesting that in these cases an old pit was partly filled with material which had just been cut from a new pit, and that therefore there is possibly a fourth floor pit in one of the unexcavated quadrates, perhaps in B3.

It is certain that these floor pits were dug and used consecutively and not simultaneously, and it also seems clear from the close replication in pattern seen from one pit to another, and from the fact that they are clustered together and not scattered haphazardly over the floor of pit B, that they were dug at regular, probably annual intervals, and by the same group of people. Pit B, then, was in use for a minimum of three and a possible maximum of five years.

In speculating about the effect of the existence of stored food and seed on the mobility of such a group of people, one would expect that in general, the existence of a store of food would require that its owners would reside close at hand, or close enough at hand to supervise it, until it was used up. In the case of kumara harvested and stored in autumn, this would indicate that there would be autumn

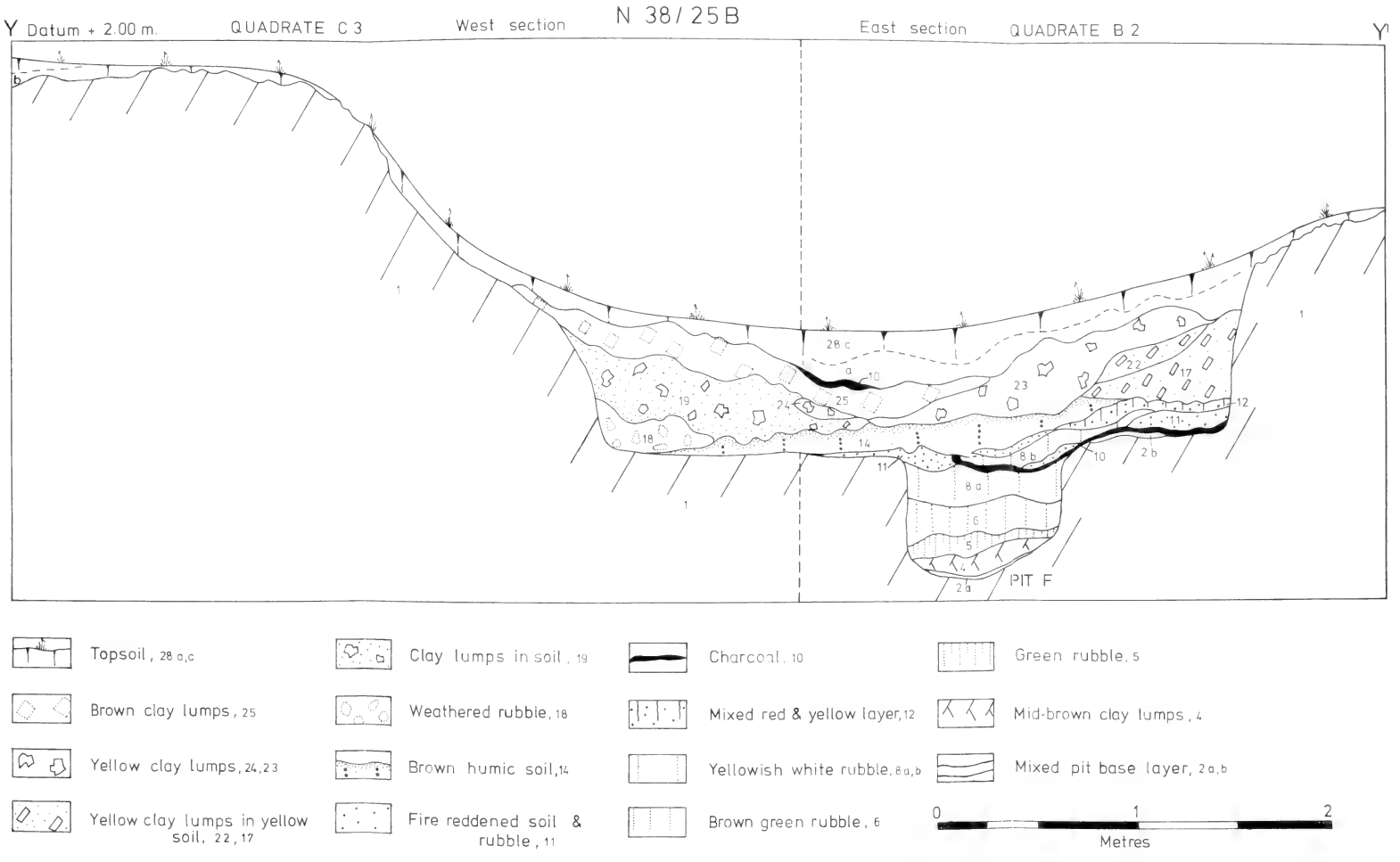


Fig. 8. N38/25B. Pit B; north-south median section of fill layers, Y-Y¹ (see inset, Fig. 9).

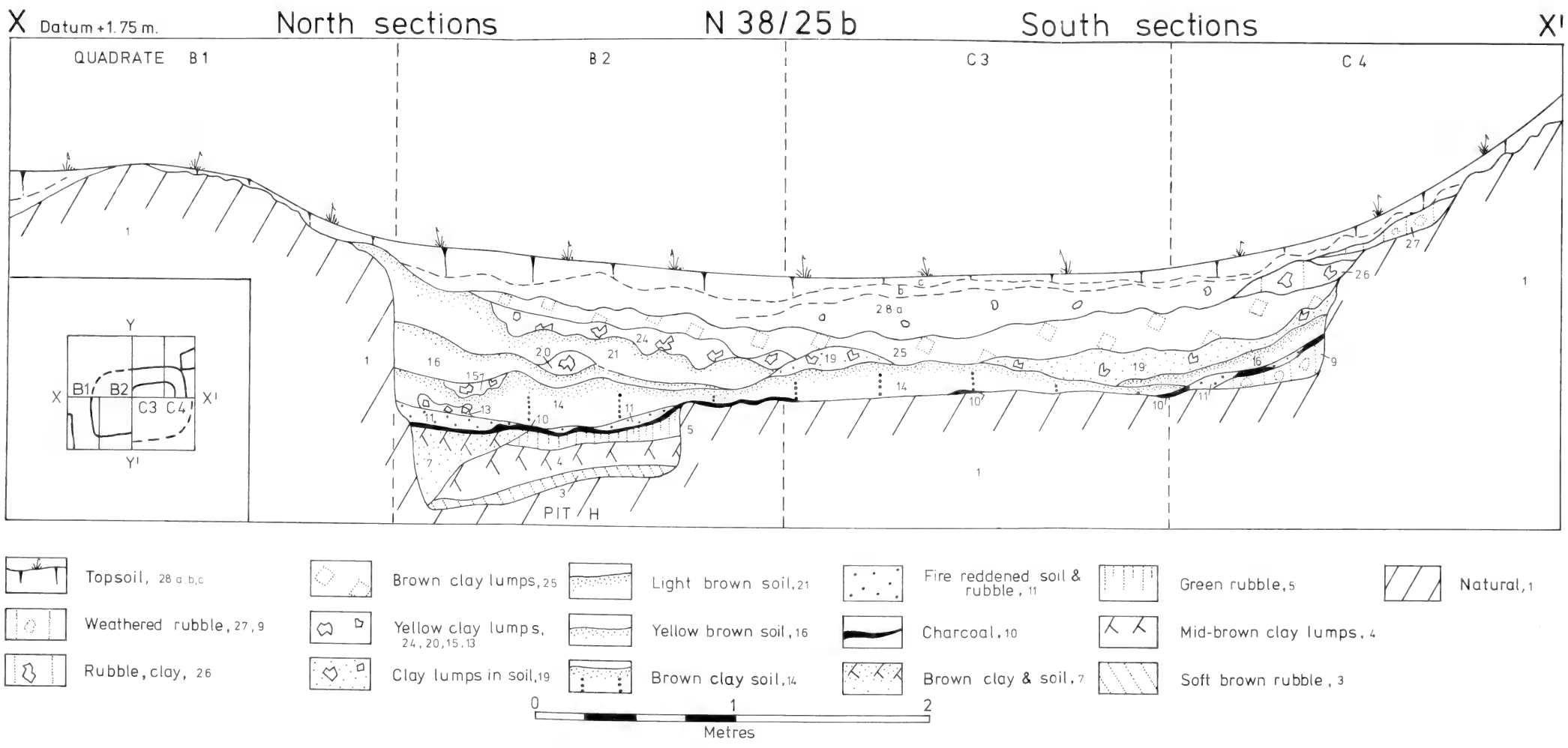


Fig. 9. N38/25B. Pit B; west-east median section of fill layers.

or winter residence, as long, at least, as the food kumara lasted. One would expect also that seed kumara would need some degree of personal supervision and occasional checking right throughout the winter, and the presumption is therefore that the owners of the pit B store would be residing in the area of Station Bay from perhaps the beginning of May until the end of August.

Thus, the floor pits in pit B appear to document the presence during the winter at Station Bay of the same group, possibly the same household for at least three consecutive winters, though giving no indication as to whether the group was there in summer or not. However it seems probable, though not conclusive, that if seed kumara were stored over winter on Motutapu they were also planted there in the spring, so that the group may have been somewhere in the neighbourhood in the spring planting season.

THIRD PERIOD OF ACTIVITY

After use of the floor pits, during the second period of activity, perhaps three years, perhaps slightly more, use of pit B was discontinued and the roof no longer maintained. Possibly part of the roof was dismantled for use elsewhere, or there may have been partial collapse over a fairly short period of time.

In any case, there was a short period of abandonment during which layer 2b, a thin layer of ash, appears to have accumulated on the floor of quadrate B2 by being blown in by wind from the area of structure W, through the apparently open west gable end. The east end was also open, and the roof in the north - east corner in a sufficient state of disrepair to allow a small amount of erosional fall-in from the high north - east corner to accumulate at the bottom on the east side of quadrate C4 (layer 9, Fig. 9).

At the time of abandonment of pit B, the three small floor pits had been filled to roughly the level of the original floor, but the sites of the filling were either known or clearly visible.

After the short time of disuse, before there had been any extensive natural deposits, and while the pit floor was largely still clean, the pit was once more utilised, this time for a short period only, perhaps not more than one day.

During this time, surviving rubbish and debris, including, clearly, from the clean condition of the floor generally, the remains of the roof, was raked up from the floor of pit B. This debris included fallen posts, and tree fern stems, and also tree fern fronds in some quantity, possibly the remains of coverings for the floor pits, and for the floor of pit B itself when used to store food kumara.

Any posts still standing appear to have been rotten, suggesting that the time of disuse had been at least several years long, and if any were still standing they seem to have been wrenched off at ground level, leaving the rotten butts in the ground.

All this debris together with a considerable quantity of additional material, mostly fronds of bracken *(Pteridium aquilinum* var. *esculentum)* wrenched up by the roots, and apparently dead and dry, but including some small forked branches, was used to kindle and keep burning for some time a large hot fire on the filled in top of pit F.

The burnt debris included a number of fragments of plaited *Cordyline* leaf, identified by Miss J. H. Goulding of the Botany Department of the Auckland Institute and Museum, who suggested that the fragments could form part of the plaited rim or handle of a basket. This seems very probable, as there are fragments of plaits of varying thickness. A thin fragment measuring 5.6 cm in length, 1.0 cm in width and 0.4 cm thick (Fig. 10), could be part of a plaited handle, and a fragment consisting of two thicker plaits each measuring 5.0 cm in length, 2.0 cm in width and 0.6 to 0.8 cm in thickness and separated by a thin crust of earth (Fig. 11) may be portions of the two sides of the rim of an empty flattened basket. These two thicknesses of plaiting are very closely paralleled by the difference in thickness on handle and rim of a *Cordyline* leaf basket in the Ethnographic Collection of the Auckland Institute and Museum (No. E.7690).

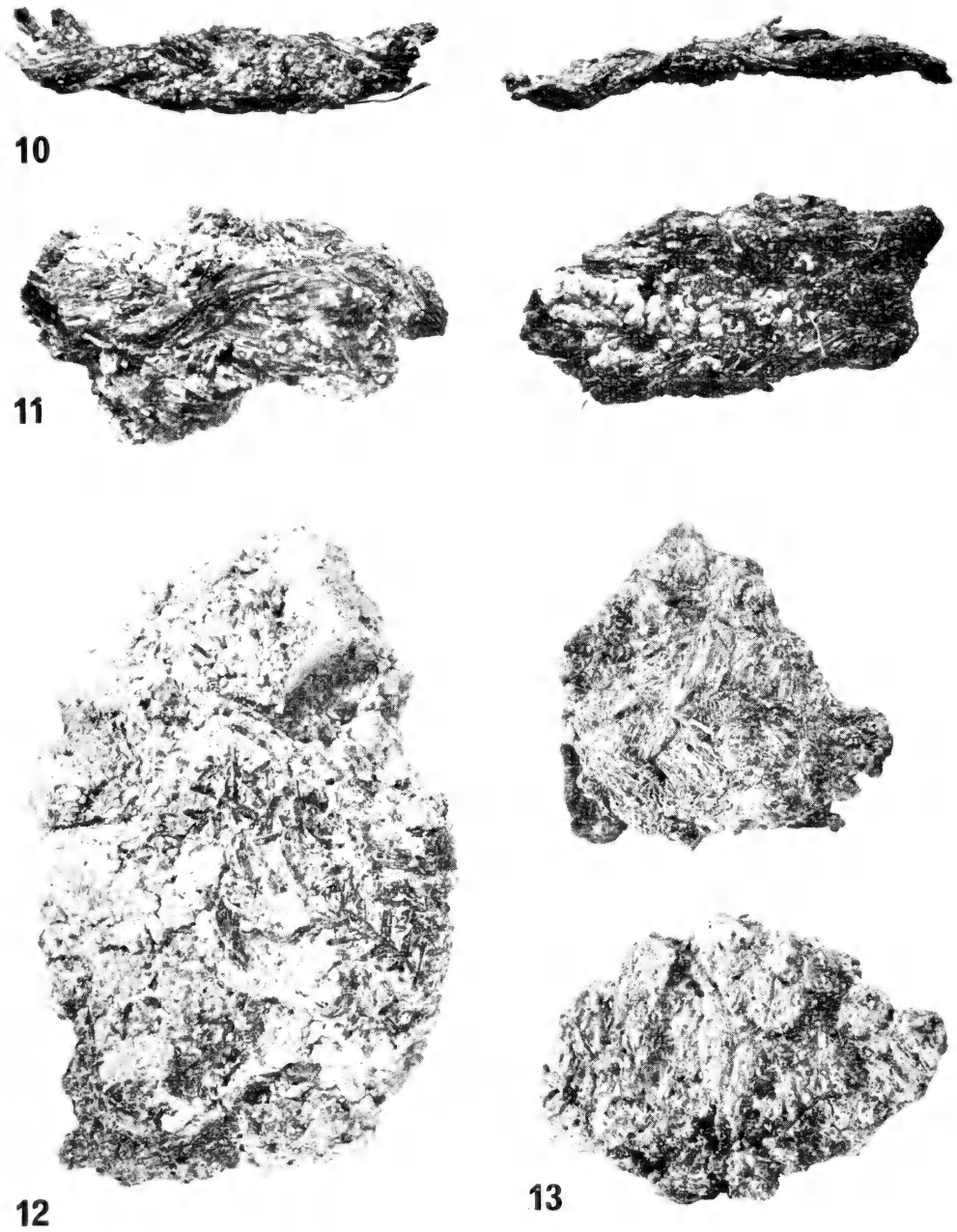
These fragments could represent abandoned storage pit debris, and in this case could tend to confirm that storage of tubers in pit B was in such kits. However it is alternatively possible that the kit belonged to one of the members of the fire-lighting party and was accidentally burnt, as by the comparison suggested above, the basket in question appears to have been the standard *kete* type of container, of rectangular shape when folded flat, which had numerous uses as a personal gear bag and an all-purpose receptacle.

The fire which was lit on the upper surface of the fill in pit B does not seem to have been lit as a cooking fire. No cooking stones and no stones of any kind were found in pit B at this level, and the only food debris located over 15 square metres at this level was a strictly localised patch, 20 cm across, beside the south wall close to the seat of the fire. This consisted of flaky, heavily calcined very fragmentary shells of a mussel species and a gastropod, and strongly gave the impression of rubbish shaken out of the upturned bottom of a bag, and then accidentally burnt in the fire.

The fire was possibly lit partly for warmth and shelter by a party spending the night in the bottom of the disused pit. In any event, it burnt strongly and for some time. It was lit on top of the upper layer of fill in pit F, layer 8a (Fig. 8), a softish well - weathered layer of earth and pieces of rubble.

The effect of the heat of this strongly burning fire penetrating down into the material below, was to convert the top 15 cm of layer 8a from a yellow-white colour to strong shades of red, brown and purple. Much of this material appeared indistinguishable from soft earthy haematite. The suspected colour change was checked by heating some layer 8a material to red heat in a wood fire. When cooled it was found to be identical with material from the red layer (layer 11).

When the fire died down on the centre of the pit F fill, it was raked out. The rake - out was vigorous and thorough and scattered pieces of burnt timber and tree fern right across from one side of pit B to the other. Debris from the fire was found against the base of the north wall in big patches of up to 60 cm, and a large quantity of it was scuffed right up against the east wall on top of the fall - in layer, layer 9. This material included a lot of tree fern fragments, and some solid timber ends up to 20 cm long and 8 cm in diameter. On the other side of the fire, much closer at hand, against the west wall of pit B, was a piece of massed fibrous aerial roots of tree fern measuring 40 x 7 cm, and a carbonised forked branch of 4 cm diameter and 20 cm length, as well as numerous smaller pieces. Charcoal



Figs. 10-13. N38/25B. Plant remains, pit B, all actual size. 10. Front (left) and profile (right) of fragment of plaited *Cordyline* leaf. 11. Front (left) and profile (right) of fragment with two thicknesses of coarsely plaited *Cordyline* leaf and layer of earth between. 12. Leafy fragments of fronds of bracken, *Pteridium aquilinum* var. *esculentum*, broken and superimposed. 13. Two typical examples of fragments of decomposed plaited *Phormium* leaf fibres.

round the edge of the fire was trodden underfoot in the process. Small fragments of the leafy parts of the fronds of bracken (Fig. 12) and tree fern settled in a thick shower around the perimeter of the fire, from the draught created by its burning, and were trodden into the floor, especially the Rangitoto ash strewn floor in the south - east corner of quadrate B2, forming a crushed mass 1 to 2 cm thick which contained as many as 10 layers of carbonised fern pinnules.

In addition to the charcoal rake out, of burnt log ends etc., the reddened earth forming the fire bed in pit F, and representing the depth to which the fire's heat had penetrated into layer 8a, was also deliberately raked out. Layer 8 material occurred only in the fill of pit F (8a) and in a couple of lenses (layer 8b, Fig. 8) which lay on top of red material on the floor of pit B on the south side of pit F. This red material itself lay on top of the deposits of fine charcoal already mentioned here. The explanation of this situation is clearly that the fire - reddened material was scraped out of the top of pit F, and dumped around it on the south and west, and that the scraping continued down to the unaltered layer 8a material, some of which was also scooped out and dumped on top of the red material. The underlying layer of small fragments of bracken and fern pinnules was partly scuffed down on to the clean surface of the layer 8a material in the process. In a couple of patches in pit F, there were still traces of the unraked fire bed where pieces of burnt wood were embedded in a base of fire reddened earth about 20 x 10 cm.

Over most of the surface of the red layer, which consisted of a number of lenses, and also occurring under the red layer, and lying through thick patches of it, was a considerable quantity of fine, pale, buff-coloured to bluish, unburnt fibrous plant material. This lay in a few large patches (up to 15 by 5 cm), and a good many smaller ones, and covered most of the area of quadrate B2 but did not occur outside it. This material (Fig. 13) was identified by Miss Goulding as the badly disintegrated remains of a fabric of *Phormium* fibres, consisting of narrow strips of leaf closely plaited, and conceivably the remains of a basket, cloak or mat. The amount and area of the material suggest a large rather than a small object and the fabric closely resembles that of a bundle of old matting collected in 1928 from Anawhata on the west coast of Auckland (Ethnology Collection, No. 23883.2).

It is most unlikely that a sleeping mat was spread out for use on the uneven surface of quadrate B2. In this connection also it is hard to suggest why, if the fire was only lit for warmth by a party making a stop over in the large pit for temporary shelter, and isolated as it was at the bottom of a deep clay pit, it should need such vigorous raking out as to scatter large pieces of burnt fuel a distance of over 3 m, and why the fire bed should be scraped clean at the seat of the fire.

It is tentatively suggested that one possible interpretation for this set of circumstances is that fire-reddened material may have been utilised for the purpose of manufacturing red ochre, perhaps for ritual purposes, and that in pursuance of this aim the fire was raked, and the material scraped up into piles, and then dumped onto an old piece of fabric, possibly a sleeping mat, and sorted over to extract the most concentrated nuggets of ochreous material out of the more diffusely coloured earths. The piece of fabric would have been put down after the red earth had been scraped out of pit F, and most of the sorting would have taken place over the site of pit G where the red layer is thickest, and most mixed up

with scraps of the matting which was evidently so damaged in the operation that it was not worth while retrieving it later.

A characteristic of the argillite clays of the east headland is the presence of sufficient iron bearing material to redden the whole fabric of the clay when heated, and this must have been well known to the inhabitants or users of the area. Red ochre was a commonly used commodity, fragments of it being found at a large proportion of New Zealand prehistoric sites. Walsh (1904, p.5) listed among its uses the painting of ornamental parts of buildings and canoes, and noted that it was extensively used as a personal decoration. It was also (Best 1924, p. 54) used in funeral and burial practices, so that some access to a source of red ochre must be considered a social necessity even for a small or isolated community.

Haematite is met with in a number of different forms. In the red earthy variety it is relatively common as soft red deposits intercalated with non-red beds in Tertiary and Quaternary formations, on the mainland. In the north of Motutapu, most of the strata are Mesozoic and considerably indurated. No soft beds of earthy haematite would normally occur in such formations. In the softer Tertiary material in the southern part of the island, none have been seen outcropping. It seems probable therefore that there was no source of earthy haematite as such on Motutapu. But there would probably be a continuing demand for it. There is no way at present of estimating how much effort, if any, was devoted to painting buildings and canoes on Motutapu but it is probable that personal adornment claimed some attention, and that occasional deaths would create demands, possibly acute on occasions, for ceremonial red pigments.

Three burials containing a total of four individuals have been uncovered in archaeological investigations at Station Bay (Davidson 1970 b, pp. 43-44; Leahy 1970, pp. 67-68; Davidson this volume, p. 2). A small group, possibly wintering in the area, faced with a sudden need for red ochre, and having insufficient on hand, might prefer to avoid a fifteen mile canoe journey to an area like Waiwera where red earthy haematite is available, and might conceivably have utilised the chemical properties of the weathered clay of the east headland ridge to convert it by heat to red ochre.

Such a practice would probably not be general; it would be expensive in terms of fuel, would need particularly dry, fierce burning fuel, and it would be inefficient, as it would be possible to convert only a small quantity of clay to ochre on one occasion, and most of the converted material might have to be rejected as being of poor quality, leaving perhaps only a few pounds of lumps of concentrated pigment as the result of effort. But as a stop-gap practice it might have been followed occasionally.

Only a very few lumps of concentrated pigment were recovered from the material in pit B, most of the pigment being either diffused through the soil in minute particles and useless as colouring matter, or else occurring only in tiny chips averaging about 0.5 cm in diameter. This might tend to strengthen the possibility that the material had been picked over.

RESIDUAL ACTIVITY

After the episode of fire making, the ochreous material and the fragments of plaited fibre were left lying on the bottom of pit B exposed to the weather. The

surface of the layer collected a large puddle of muddy water, and many fragments of the fibres of the now almost totally rotted and disintegrated fabric sank to the bottom of the puddle to be incorporated in small thick wedges of mud and tiny red rubble chips, which were now filling up the hollows in the surface of layer 11.

Later, a thick layer of brown clay soil was deposited over the whole surface of the pit (Figs. 8 and 9, layer 14), and probably carried some type of vegetation cover. Cultural layers in the fill of the pit after this mainly record the peripheral effects of activities elsewhere. Layers such as 17 and 23 in quadrate B2 appear to be the result of dumping from the south, recording earthworking in the area, and form part of a series of deposits of restricted extent which appear in pit B from the west and south. The next layer to cover a large part of the whole area is layer 25, a layer of hard mud coloured lumps of clay set in a thin muddy sediment, which may record an episode of prolonged torrential rain eroding cracked clay surfaces up the ridge.

This layer left a rough cobbled surface of muddy lumps spread over pit B, and on it, just before the modern black soil horizon began to form, a transient party kindled a cooking fire in the central hollow at the north end of quadrate B2. The pit had by this time received a substantial amount of fill, both natural and artificial, but there was still enough of a dip left in the central hollow to provide worthwhile shelter for a cooking fire on the exposed windy ridge top. This group of passers - by ate a meal of rats, fish and shellfish from an oven containing cooking stones heated over a fire fed largely by small twigs and grassy plants.

During the first part of the period during which the modern topsoil was forming, there were further up the ridge either still occupied sites, or else older exposed sites, from which a layer of cooking stones worked its way down into pit B, at the base of the second layer of topsoil.

In this layer, in quadrate C3, there were also two thin grey argillite flakes, apparently struck off an adze blank and carried downhill in the soil with the cooking stones.

STRATIGRAPHY OF FILL LAYERS (Figs. 8 and 9)

A characteristic of the stratigraphy in pit B was the discontinuous nature of deposits, which only occasionally covered substantial areas of the whole pit. Typically, layers originated at specific areas of the pit rim, spread down the pit side some way and interfingered either laterally or frontally with similar layers.

Layer 1. Clay natural. This was the outermost, most weathered skin of the weathered outer zone of the argillite substrate. It appeared to be divided into three beds in the site area. From the east, these have weathered as follows: a, pale yellow clay; b, pale grey-white clay with rust streaks; c, brown-yellow clay. The sequence of colours of moderately unweathered rock was not established, but b at 1.3 m had deepened from pale grey to a sea-green colour, and one of the yellow clays was possibly blue at this depth, as a few chips of bluish rubble were found. The clay natural was very eroded and angular and shattered easily on the north wall, but was soft and wet with unimpeded present day drainage of rain water into the pit, at the level of the original floor, when first excavated, suggesting once more that a good roof was needed.

Layer 2. Mixed pit base layers 2a and 2b. 2a is 0.8 cm or less in pit F and up to 1.5 cm in pit G. It was a cultural composite of red rubble and charcoal in tiny fragments in Rangitoto ash. It is of interest as showing the possible use of fire to redden clay (either intentionally or unintentionally) before the episode of burning in pit B. Alternatively this may have been just the normal fine flecks of red ochre to be expected about a living site. The constituent of Rangitoto ash in 2a was continued in 2b, which is the pit base layer of pit B. This was a lens of up to 2 cm in thickness of what was apparently unmixed ash at first. Flecks of charcoal and ochre in this were the result of the fire. 2b was the first of the discontinuous lenses in pit B, and was a disuse layer, whereas 2a is a use layer.

Layer 3. Soft brown rubble; base layer of fill in pit H. This material was partly soft clay-derived earth and partly angular but soft rubble fragments. The whole layer was a brownish yellow, compact but easily removed and crumbling on removal, unlike the layer above.

Layer 4. Mid-brown clay lumps, of similar colour to layer 3, but consisting of thick lumps of clay, about 10 cm in diameter; these lumps when broken open showed a brown yellow colour without much trace of the streaking characteristic of the clay natural of pit B. The colour was similar to that of the natural in structure W, suggesting that it had a source on the west of the ridge. Water seepage through the floor pits was heavy, and they were obviously acting as drains at the present day. Clay lumps were moist, plastic and deformed by pressure, and though tightly wedged were coated with a rusty mineral, probably limonite, over the surfaces of each individual lump. Layer 4 occurred in all three pits; in H as the second layer, in F as the layer immediately above the thin trodden-in layer 2a, and in G it constituted the entire fill of the pit.

Layer 5. Green rubble. Layer 5 seems to have consisted originally of fragments of greenish rock, freshly dug from a depth where the natural kept this colour. The immediate source of green rock rubble was the rock natural at depth in pit B, and the conclusion is that where green rubble was found (in pit H as the top layer of fill, and in pit F as the second deliberate fill layer), it was being dug out of one pit and put back into another almost immediately. As a fill layer the material became compressed, but the original angularity was still perceptible, as well as the strong marking of rusty joint minerals, which persisted in its well weathered whitish condition.

Layer 6. Brown green rubble. A layer basically similar to layer 5, but a decidedly more brownish colour. Apparently layer 5 material which had weathered by exposure to the atmosphere for a time after being cut, and before being carted in as a fill. It is unlikely that layer 6 just represented the weathering of the upper part of layer 5, as layer 5 material was unweathered at a higher level in pit H.

Layer 7. Brown clay and soil. This appeared to be a mixed layer having clay lumps like those of layer 4 and brown soil, like that of layer 3 though with much less rock rubble. Pit H, the only place where this layer was found, was filled from the east end with loads from three sources, layers 3, 4 and 5, which left a sloping pile almost filling the pit at this end, while the west end was almost empty. The gap at the west end was possibly filled by scraping up the remains of dump piles of several kinds.

Layer 8. Yellowish-white material. This was a distinctive, semi-angular, much weathered material, with yellow and whitish shades about equally prominent; the yellow material carrying a mosaic of rust-coloured lines and patches. Layer 8a seems to have

been the primary layer, with layer 8b appearing to be a number of patches of material displaced from the top of layer 8a. Layer 8a was also the source of layer 11, fire reddened material. Texture and patterning of 8 and 11 were identical. The source of layer 8a was uncertain. Possibly it was a mixed layer like 7.

Layer 9. Weathered rubble. 27 and 9, with 26, represented fall-in erosion layers from back walls, and were obviously not enough to represent the collapse material of a vertical back wall; indicating that the north wall was originally angled back from vertical.

Layer 10. Charcoal. All the charcoal at the level of the floor of pit B appeared to represent the product of a single episode of burning centred in pit F from which a volume of about 0.125 m^3 of charcoal was recovered; this was about 50% timber fragments, 40% tree fern remains, and 10% bracken. There was a small upper lens of charcoal on the surface of layer 25 which represents a much later fire.

Layer 11. Fire reddened soil and rubble. Consistency varied from soft rather crumbly soil to broken down angular fragments, layer 8 having a similar consistency. The most distinctive aspect was the reddish colour, ranging from a pale pinkish orange through bright orange brick shades to red browns and deep purple browns. Layer 11 material was concentrated in patches in quadrate B2, but had apparently spread a little into quadrate B3, and a thin layer had been raked out with charcoal from the fire against the east wall of pit B (Fig. 9).

In, on and under this layer was the remains of the rotted *Phormium* fabric. This had to be removed piecemeal attached to red material, but the total quantity removed would cover at least one square metre without taking account of detached puddled fibres. The surface material was localised around the edges of quadrate B2, so that apparently the fabric had been at some time spread out across the area of most of B2.

Fire reddened lenses of layer 11 had a variable depth of from 2 to 20 cm; the thick 20 cm deposit in pit G contained the embedded fabric scraps, but showed no signs of water puddling which was clearly recognisable just beside it.

Layer 12. Mixed red and yellow layer. This was made up of confused patches of layers 8 and 11, and patches where mixing of 8 and 11 was more thorough. It seemed to be the boundary layer between red and yellow, scraped out of the firebed and mixed in the process.

Layer 13. Yellow clay lumps. Layers 13, 15, 20 and 24 were very similar layers of massive hard lumps of weathered yellow clay, up to 20 cm in size. Lenses 13 and 15 were small, though containing large lumps; the texture and consistency of this "clay" appeared to be largely the result of exerted pressure, either from levering tools like digging sticks, or from the pressure of foot traffic over material close to the ground surface. Layer 13 seemed to have fallen into the pit from the western side, where the ground surface provided a natural path down the ridge along the baulk between B and W and where some rolling down of material from higher up the ridge was to be expected on a limited scale.

Layer 14. Layer 14 was more extensive than any preceding deposit on the surface of the clay natural. It was a thick layer, though overall it thinned out towards the south side of pit B, being about 30 cm deep over the surface of pit H. It had a fairly homogeneous appearance, being a distinctive khaki brown when damp, but drying out to a

faintly purplish brown. The material is probably best described as a clay soil. It had a structure of small lumps averaging about 0.5 to 1.0 cm and consisting of a stiff clay based material. It contained a proportion of small (about 2 mm) unassimilated lumps of yellow clay, and angular rock rubble fragments of an orange colour, as well as similar sized flecks of charcoal. It seemed to have had a population of soil organisms at some time. Its relatively uniform appearance and fairly even spread suggested that it was deposited in relatively stable conditions. It seemed to represent a period when at least some of the area of site N38/25B was being allowed to lie idle and form some sort of vegetation cover. The thickness of layer 14 in pit B suggested that this period of apparent freedom from human interference was a relatively long one, and that during this time the natural processes of downhill soil creep and fall-in deposited layer 14 in pit B, in much the same way that the present thick topsoil layer has been deposited in conditions of freedom from mechanical disturbance. However, too much should not be made of indications of lack of activity in the immediate area. This layer, layer 14, was the lowest layer of fill in pit E also, and the evidence from pit E tended to show that there were still people around, though not actually on the spot.

Layer 15. Yellow clay lumps. An isolated patch similar to 13, and from the same direction.

Layer 16. Yellow brown soil. Layer 16 was a yellow brown soil, distinctly lighter than layer 14, and containing more clay, some small orange lumps, and some larger yellow lumps up to 5 cm. It occurred as discontinuous lenses of apparently identical material at two ends of the pit, and seemed to be replaced in the north central part by layer 18. These layers clearly reflected a change of surface conditions, perhaps some clearing of vegetation, which set surface material on the move into the pit again, and exposed the back wall in part to erosion and fall-in.

Layer 17. Yellow clay lumps in yellow soil. This was the first of a series of rather thick discontinuous lenses or wedges of material which entered pit B over the top of its south lip. The excavated part of layer 17 was confined to the south central area of pit B, thinning out and disappearing both towards the west wall, and towards the central concavity of the pit. Layer 17 consisted of large (10-15 cm) yellow clay lumps, with pockets of yellow soil, derived from clay material. Layer 17 was clearly a layer of cultural origin, as there was no natural source of such a quantity of material on the south of the pit, where the top of the rim was 1 m or less wide, before it descended to the narrow flat area below. There had been earthworking activities here, and layer 17 marked the first record of them in the fill of pit B.

The original profile of the ridge had a low point in the area of this strip of ground below the south edge of pit B, which must then have included the area in which the defensive ditch was later dug. From the excavation of a narrow strip which ran from quadrate B2 to the north edge of the ditch (which drops sheer from the flat area) (Davidson, pers. comm.), it was seen that the south wall of pit B, where it sloped down to this flat (a vertical distance of about 1 m, so that its surface and the flat floor of pit B are about at the same level), had been cut back artificially to form a flat-surfaced scarp angled back at about 45 degrees. It is possibly some of the clay removed in this cutting back of the slope which was heaved over the top of the rim into the south side of pit B and which makes up layer 17 and layer 22. This shaping of the slope must have come after the cutting of pit B because it seems unlikely that the builders of pit B would have placed their south wall quite so close to it. This activity of wall shaping, linked with a vague hollowing out of the ground surface at the foot of it, can

possibly be assigned to an initial attempt to construct a defensive ditch a few metres north of its final position. This first attempt to dig a ditch (if it was so) may have also been linked with an intention to fill in pit B by pushing fill up over its south lip (layers 17, 22 and 23), an intention which was not carried to completion. This was probably connected with the shifting of the line of the ditch five metres further south, which would make the filling of pit B unnecessary to the construction of the ditch.

Layer 18. Weathered rubble. Layer 18, however, was slightly more mixed in character than the designation suggests. Besides rubble it had lumpy yellow brown clay soil, and may have incorporated part of layer 14.

Layer 19. Clay lumps in soil. This was another localised fill layer. It was thick and seemed to have poured over the back wall of the pit, so it possibly represented a flood torrent load over a mainly rather bare clay surface. It was a layer of pale brown to pale yellow brown clay lumps, about 5-8 cm in diameter in a packed and hard pale brown clay-derived soil. It also contained a few lumps of yellow clay which seem "clean" in relation to the rest of the material.

Layer 20. Yellow clay lumps. The end point of a fan out of material over the baulk from structure W; renewed activity here occurring long after the complete disuse of pit B. The lumps of layer 20 were 10-20 cm thick and formed a single layer blanketed and penetrated by other layers, especially layer 21.

Layer 21. Light brown soil. Identical with 21 in structure W, except for thin streaks of Rangitoto ash in layer 21 in pit B, close to the west wall. This material seemed to have a tendency to ooze out under the layer 21 material where the latter was thinned by foot traffic down the baulk path, so patches of ash appeared to indicate passers by, scuffing this material over the edge.

Layer 22. As seen in quadrate B2, layer 22, was only the thin lateral part of a wedge which fingered in between layers 17 and 21, but petered out after less than a metre. It was very similar to layer 17 and the division is possibly arbitrary. It contained more soil and fewer yellow clay lumps.

Layer 23. Yellow clay lumps. This layer, like 17 and 22, lensed out to the west, but went much further into the centre of pit B. Like 17 and 22 again, it represented earthworking in the area below pit B. It may represent the cutting back of the slope below pit B, though it might also be some of the material removed from the existing ditch, and dumped in pit B. Layer 23 consisted of massive yellow clay lumps up to 30 cm in diameter. These were close packed with little or no softer material between them, and in section showed the form of a classic dump cone, clearly indicating their source on the side of the short slope of the cone. Their passage over the rim top of pit B was clearly marked, too, by the erosion of the surface few centimetres of clay which can be seen on the south rim of pit B in Fig. 5 on the east side of quadrate B2. Lumps of this size indicate major earthworking, and considerable effort expended even to roll them up the slope into pit B. When broken open, the lumps show a homogeneous clean yellow colour in the centre, with some lumps having a band of about one centimetre round their peripheries which contained inclusions in the form of minute flecks of disintegrated charcoal. In an area such as Station Bay and its east ridge, occupied over prolonged periods, such charcoal is an indication of the lack of any occuption in the immediate vicinity at the time of deposition of the layer containing it, but also an indication of the possibility of settlement either not too far away or not too long ago.

Such comminuted charcoal was observed in layer 14, and also in slightly different company in layer 2a.

Layer 24. Yellow clay lumps. Layer 24 was basically similar to layer 20, being a single gappy layer of clay lumps. However, 24 clearly came down from the north or northwest, and seemed to indicate activity in that area also. Its bulk lay in the unexcavated quadrate C2.

Layer 25. Brown clay lumps. Like layer 14, layer 25 was a quite extensive layer, apparently indicating the termination of much of the previous activity. It was a layer of possible cultural origin, but naturally deposited from a flood torrent. It consisted of 8-10 cm lumps of brown muddy looking clay, showing some faint yellow central patches, the whole packed extremely hard, and set in a thin hard mud layer of the same muddy colour. It was clearly a flood pile, but the material gathered up by the waters on their way down the ridge could quite well be spoil from recent earthworks. Layer 25 formed an extensive sheet in pit B and reached further towards the slope of the south wall of pit B than shown by the point it reached in the line of section; coming in fact within a metre of the south wall. It was on the not very comfortable surface of this deposit that a late cooking fire was lit and an amount of food waste scattered just before topsoil began to form. This midden material, belonging to the top of layer 25, was actually collected right through the depth of the layer where it had fallen through gaps as far as the surface of layers 21 and 14, owing to the lensing and discontinuous nature of the layers, and the gaps provided by the various clay lump layers. It was restricted to the north end of B2 with a slight extension into the south of C3.

The midden material was heavily eroded and fragmentary, as well as being of limited amount. Among the shells there were a few periwinkles, *Lunella smaragda;* sizes of opercula along long axis, followed by number of individuals, were as follows: 0.4 cm (1), 0.5 cm (1), 0.6 cm (2), 0.8 cm (4), 1.1 cm (2), 1.3 cm (2), 1.4 cm(1), a minimum of 13 individuals. Eroded fragments of other gastropods amounted to about the same number. The presence of the only cockle *(Chione stuchburyi)* appeared to be accidental, as the valve measured 0.9 cm across. The other shells all seemed to be rocky shore species which would probably be available close to or in Station Bay.

Most of the midden material was fish bone, including left jaw fragments of a minimum of five small fish. Four of these fish were snapper (*Chrysophrys auratus*). The bones were mostly head bones, with a number of vertebral spines.

Rat bones included jaws of three different individuals.

The fire which cooked this meal was located right at the bottom of the hollow of the pit as it then existed, in quadrate B2. The charcoal and stones accompanying it were recovered largely from the base of layer 28 which covered it over. The site of the fire was marked by a localised black staining of layer 28, and by a rather small amount of charcoal. The material of this fire was scattered over the shallow surface of the pit, and remains gathered around the site of the fire consisted of a few grams of short thin stalks about 2 mm in diameter, though it is possible that material in quadrate B2 (consisting of about a dozen pieces of blocky charcoal ranging from 2 to 5 cm and collected on the surface of layer 14 where it had apparently fallen through gaps) represented the remains of more solid timber used in this fire.

Layer 26. Rubble clay.This was a restricted patch of material in the north-east

corner of the east wall of pit B. It contained angular rubble fall-off from the east wall of the pit immediately behind it, which had been mixed with a number of small (about 5 cm diameter) lumps of yellow clay, possibly from the flat ground at the top of the wall.

Layer 27. Weathered rubble. This deposit of whitish weathered angular rubble pieces, was possibly more or less *in situ* material eroded off the north-east corner but not fallen very far from its original situation.

Layer 28. Topsoil. This layer, present over the whole ridge top, was about 50 cm deep in the centre of pit B. It was dark coloured, black looking when damp, drying out to an ashy grey. The material had a crumb structure and individual particles broke down to material indistinguishable from weathered Rangitoto ash, when crushed. In this thick layer there were several marker horizons, discernible in the deeper deposits, but not seen in places where the layer thinned out over the baulk, and on the north and south rims of the pit. On the north it thinned to vanishing point, and when the grass was removed initially the upper ground surface was found to be composed of clay lumps in several places, but it began to thicken again in a pronounced way in the middle of the area dividing pit B from pit C, which possibly indicates some sub-surface structure on the edge of pit C. Topsoil zone a, the lowest zone, had a basal layer of minute angular white rock rubble chips, with a few orange pieces. This base layer appeared only in the central hollow of pit B, and was probably collected by the very light scraping which the topsoil would give the north wall of the pit as it progressed down it, the obvious direction of emplacement of the topsoil being from the north and from higher ground generally.

A lot of the midden material from the last fire was recovered from the bottom few centimetres of the base of layer 28, as were most of the stones of the cooking oven, and all of these are, of course, to be related in the sequence to the interface between 25 and 28. The localised black staining and thin charcoal remains of the fire were also as previously mentioned, mingled with this base layer of 28.

In the north-east corner of B2 against the east wall of the quadrate, there was a thick scatter of large fragments of hard, only slightly weathered, argillite rock, which was a dark grey on freshly broken faces. The largest fragment was 12 x 8 cm. This was jointed, though some joints were quite widely spaced. Surfaces were angular fracture surfaces, though some of the material showed pebble surfaces. A few showed signs of heating.

Zone b of the topsoil contained no small rubble chips, but in quadrates C3 and C4 it appeared to contain a surface marked by a rather uniform scatter of stones smaller than some of those previously encountered but otherwise very similar. These were probably too high in the layer to be associated with the fire on the surface of layer 25. The stone scatter was very marked at the top of pit B, in the flat area in C3 and C4, and seemed to have worked its way downhill in normal soil movement from some area of concentration higher up slope. All the stone appeared to be the same fractured dark grey argillite except for a 5 cm pebble of black vesicular lava from B2. This was lensoidally flattened, and there was also a larger pebble (12 x 8 x 4 cm) of a greenish gritty conglomerate, possibly from a beach on the south or west of the island, which had had four rough flakes knocked off one end, in two directions, and could have been a rough chopper or pounder. Two flakes of dark grey argillite of a material apparently identical to that of the ubiquitous lumps were possibly flakes struck on a

large cobble to prepare an adze blank. One was subtriangular in shape, with a narrow curving waterworn surface on one rim, and was 3.8 x 3.5 x 0.4 cm. The other larger flake measured 5 x 5 x 0.3 cm and was roughly rectangular with one large pebble surface. This flake was almost razor thin along one edge, and this edge showed signs of use. Both of these flakes were found in the line of section on the east wall of C3, just west of C4, at a depth of 25 cm in the topsoil. A third struck flake of identical material, but only 1.3 x 0.8 cm, was found at 35 cm in the same layer in B2.

Total weight of all stone in layer 28 in B1 to C4 was 37.87 kg, distributed as shown in Table 1. Most of the stone from B2 related to the late fire, as did a little of that from C3.

Table 1. Distribution and weight of stone fragments.

SURFACE OF FRAGMENT	EXCAVATED AREA			
	B1 (kg)	B2 (kg)	C3, C4, inside pit B (kg)	C3, C4, outside pit B (kg)
Fractured	1.8	8.2	9.1	3.2
Fractured, with pebble surface	0.45	2.7	3.2	0.9
Pebble	0.45	2.7	1.8	0.9
Total	2.7	13.6	14.1	5.0

The depth of black soil in pit B in the centre was about twice the average depth of topsoil outside it, and it is clear that the pit had been acting as a trap for soil moving down slope during a period of minimal interference to the ground surface. One can perhaps tentatively equate this time with the duration of pastoral farming on the island.

Pit E

This was a small straight-sided pit, narrow and flat - bottomed, the south - west corner of which almost touched the north - east corner of pit B. There is a 20 cm gap between them at present. This would have been probably at least double the width before erosion of the north wall of pit B. Pit E (Figs. 14, 15) was cut with sides parallel to those of pit B and structure W. It was set on the edge of the flat area between pit B and the next pit up the ridge, pit C. This area was about 4 m wide, but in the excavated area in quadrates C3 and C4 it was completely featureless, having only the previously mentioned scatter of cooking stones on top of an undisturbed clay natural layer close to the present ground surface.

Pit E extended out in the direction of the edge of the ridge which overlooks the sea. The excavated section was 1 m wide all round. Before excavation, the only indication of its existence was a slight wobble in the north rim of pit B (Fig. 4), at the north - east corner where the walls of each pit meet at a corner and are both rather worn down. At the edge of the excavated area on the east edge of quadrate C4, the rim of pit E was 25 cm below present ground surface, and the highest or north wall is 75 cm deep. On the south the wall ran from 60 to about 30 cm at the tangent corner, and the west wall sloped down from 70 to about 30 cm at the same corner. Pit E was 1 m long in the excavated section, and it is perhaps unlikely that it was more than about 2 m in overall length because of the seaward slope of the ridge here.

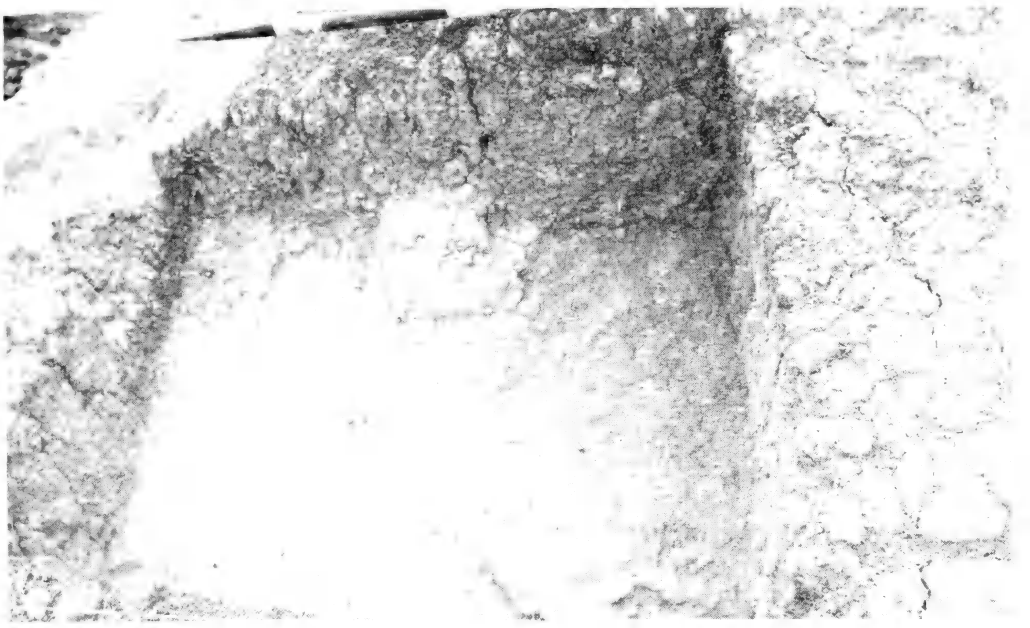


Fig. 14. N38/25B. Pit E, from east, showing small buttress against west wall.

Pit E was much higher up than pit B, and touched only its upper rim, but the two structures appeared obviously connected. There was a very small low buttress in pit E (Fig. 14) placed against the wall at right angles to the north rim of pit B. The obvious inference is that pit B was in existence when pit E was cut, and this is borne out by some similarity of fill layers. Pit E was noteworthy for the cleanness of its sides and the fairly good condition of its edges. This suggests that it did not stand open for any length of time and that it was filled soon after it was cut.

Although it is of very different shape and style, its apparent size (1.5 m long?) suggests comparison with the floor pits in pit B. Was this also a small specialised store, not necessarily a kumara seed store, for the proprietors of pit B? It seems to have been filled not very long after it was cut. The bottom layer in it was a powdering of charcoal and red ochre fragments, which seems to be a tracked-in dirt layer, suggesting that this pit was cut soon after the large fire which reddened the earth in pit B. The next layer of material on the floor of pit E was a natural one, and was identical with layer 14 in the fill of pit B. However in pit E this layer was much thinner than in pit B and its outline was distorted by layers of fill dumped on top of it. Obviously, pit E was dug beside pit B soon after the big fire. It was used for a season perhaps, and then left open and empty, and layer 14 material began to accumulate in it, probably under a vegetation cover (possibly bracken). Before the end of the period of accumulation of this material in pit B however, (perhaps one third to one half of the way through, on a comparison of the thickness of layer 14 in the two areas) pit E was filled in, and the fill carefully levelled to the slope of the ground surface (Fig. 15).

This fill was clearly artificial, the layers showing clear dump profiles, and the reason for filling pit E in an area which appears to have been overgrown,

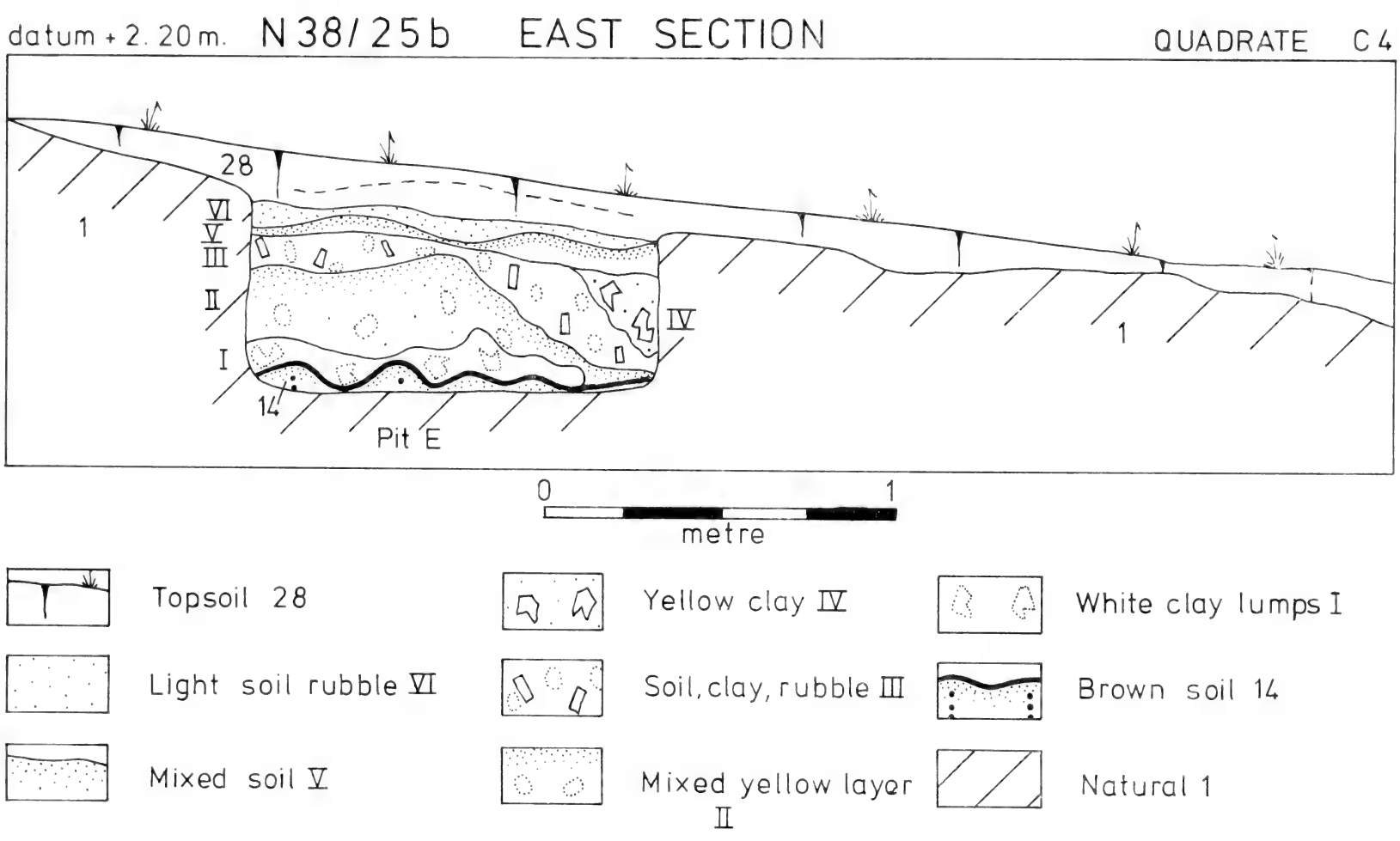


Fig. 15. N38/25B. Pit E, section of fill layers.

and which was left in that state after pit E was filled, seems to have been to remove a rather nasty little obstacle from the path down the east side of the ridge past the east end of pit B. This suggests continuance of activity in the area, probably on the pa, with frequent passage up and down the ridge via the eastern side of pit B, which is the natural side to pass when making for the north - east.

STRATIGRAPHY OF FILL LAYERS (Fig. 15)

Layer 1. Natural. Weathered pale yellow clay of pit sides and base. Slightly cracked on floor, clean on sides.

Layer 14. Brown soil. Identical with layer 14 in fill of pit B. Underlain on floor of pit E by thin streaking of charcoal fragments and red ochre chips, less than 5 cm thick; patchy. In pit E, layer 14 had been crushed and distorted by emplacement of overlying fill, and was originally perhaps one quarter of the thickness of layer 14 in pit B. It marked the fairly short period when pit E lay open and unused.

Layer I. White clay. A layer of lumps of whitish clay, 10-15 cm in diameter, with some pieces of angular whitish rubble up to 10 cm. A few small pieces of hard reddened material occur in this layer and layers II, III and IV.

Layer II. Mixed yellow layer. Yellowish, moderately soft layer of clay-derived material, with lumps of weathered rubble (5-8 cm) and flecks of yellow and whitish clay less than 1 cm.

Layer III. Soil, clay, rubble. Light yellow-brown soil, with much white clay in 1 to 5 cm lumps; a few yellow clay lumps, 1-2 cm, and some angular rubble less than 1 cm. Layers I, II and III showed in section the advancing front of a dump cone produced by layers of fill being thrown in from the north side.

Layer IV. Yellow clay. Lumps of hard yellow clay up to 10 cm, with softer yellow clay earth between.

Layer V. Mixed soil. A light brown soil layer, with small pieces of whitish clay and rubble, 2-3 cm.

Layer VI. Light soil, rubble. Similar to V, with less clay, and with pieces of whitish rubble forming a distinct base line to the layer.

Layer 28. Topsoil, b and c. Dark brown topsoil zones b (with slight stone scatter) and c (loose surface zone) as for pit B.

CONCLUSION

Excavation of four quadrates in site N38/25B gave an incomplete but detailed picture of occupation covering at least four distinct periods.

The earliest period, represented by the possible terrace, W, is rather obscure, information obtained doing little more than document artificial modification of the terrain on the ridge at a time which apparently predates the surface redistribution of the original volcanic ash blanket into smaller discontinuous patches.

The second period relates to the use of pit B, and by implication to the use of the other structures open on the present day surface, pits C and D. The sub-surface complexity of the excavated area has to be kept in mind when trying to assess the possible relationship of pit B to pits C and D. There is no apparent necessary logic of positioning here to determine order of construction, and the probability is that from their generally similar surface appearance, B, C and D were in use at much the same time. However, 'the same time' could well be a period of decades. The use of pit B is fairly reliably seen to have been for a minimum of three years, and by a single group during that time. But information about this group is fragmentary. Its storage site is known; its eating, sleeping and work areas unknown. Information about the storage unit itself is affected by the uncertainties of its unassessed relation to two apparently similar storage units. If pit B did represent the storage space of a single household, then perhaps pits C and D are storage units of two further households; household C needing less storage than the others. But there seems no valid way of distinguishing at present between this and several other possibilities, i.e. that the three pits are the clustered stores of a single large group and all in use at once, or that they represent stores built serially by a smaller group over a continuous and perhaps substantial period; and in fact, the analogous attribution of storage function to C and D may be questionable.

The third period postdates the use of pit B at least by the interval represented by the accumulation of layers 14 to 16, but there are suggestions that the gap represents a move some way off rather than complete disuse. Period three appears to cover some length of time, and to be associated with at least some part of the defensive works connected with the pa, in particular earth working preceding the construction of the northern ditch. Its characteristic is the purely peripheral nature of the use of N38/25B at this time.

Period four, late in time, marked by the casual meal eaten in pit B, seems possibly to mark the disuse of the whole ridge area as a site of occupation of any but a transitory nature.

The second period is the period of major utilisation, and this shows the distinguishing character of extensive as opposed to intensive occupation. Time, as represented by successive structures, B, G, F, H, E, is recorded very largely by lateral movement across the surface of the ground, and not by vertical stacking. The floor pits certainly cut the surface of B, but they then proceed to take successive orderly bites out of the floor space, as if the intention had been to cover the whole floor with pits in a leisurely way, if some unknown factor had not intervened, and whatever dictated the placing of pit E as a small excrescence on the north - east of pit B it was certainly not lack of space outside, or inside.

It seems reasonable to place the use of pit B, and by extension, the use of pits C and D concurrently with one of the earlier periods of occupation of the area south of the ditch.

The distinguishing aspect of the use of ground at N38/25B is its non-intensive nature, and fairly wide spacing, in general, in relation to total topography. This relates to a period of N38/25 when there was no constriction of area by a ditch, so it is possible that with a tendency to wide spacing in one part of the area at least, N38/25B overlapped with and formed part of the rest of the site.

Under these terms, then, N38/25B can be regarded as a sector preserving something of a portion of the original layout of an early period of N38/25.

The changing character of occupation on the ridge top is graphically illustrated, under this hypothesis, by the three unfilled pits B, C and D. Filling in a pit by manual methods is hard, largely unproductive work. The only product of a filled pit is a small patch of flat ground, and a corollary of this is that where pits are deliberately filled in by hand, small patches of flat ground are for one reason or another highly desirable or at a premium. On N38/25B, the floor pits in B were successively filled because the rest of the floor space was obviously in current use. Pit E seems to have been filled because it represented an obstacle in what had become a path. But occupation on the ridge never got to the point of really wanting flat ground again in the N38/25B area (although it seems to have been thought about at one stage), and consequently B, C and D were just left open; the contrast between the numerous superimposed and intercutting pits south of the ditch and the dead ground of N38/25B being a contrast between occupation which in an earlier period was at least in part extensive and undefended, and at a later time constricted, concentrated and intensive.

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THE WHANGAMATA WHARF SITE (N49/2): EXCAVATIONS ON A COROMANDEL COASTAL MIDDEN

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Abstract. Excavation of a coastal midden at Whangamata, Coromandel Peninsula, New Zealand, revealed two cultural layers separated by a wide band of sterile sand. Artifacts are described, and faunal remains are analysed with particular reference to the diet of the site's occupants.

Whangamata is a popular holiday resort on the east coast of the Coromandel Peninsula. It lies on an extensive sandspit between a large tidal estuary and a long ocean beach. The narrow mouth of the estuary is at the north end of the ocean beach and it is on the northern tip of the sandspit, along the southern shore of the estuary mouth, that extensive archaeological evidence has been revealed, both by marine erosion, and by development of properties near the shore.

The Whangamata wharf site, excavated by the author in August 1969, is situated on the foreshore immediately east of the modern wharf (Fig. 1). Here the foreshore is eroding as a result of wind and sea action, exposing a layer of shell midden near the top of the sloping sandy beach. A thin lower layer, containing obsidian and dog bone, which was eroding out further down the beach towards the high tide mark, had been discovered by Mr. R. G. W. Jolly and at various times during the previous few years Mr Jolly and other visitors to the area had made collections of material from this eroding edge.

The "wharf site" is probably part of a much larger site spread over an area of two or three acres, and now dissected and interrupted by recent sand dunes, roads and houses. Excavations at the Cabana Lodge flats, a short distance from the wharf site, by the owner, Mr East, and Mr R. G. W. Jolly, have revealed an associated flaking floor and fishhook manufacturing level. Rich in artifacts, the Cabana Lodge site seems to belong to the Archaic phase.

Bands of midden and occasional flakes are revealed in the eroded beach frontage along the estuary for several hundred yards north-west of the wharf site. It seems that these cultural remains are heterogeneous, perhaps widely separated in time, since a small excavation by Mr F. W. Shawcross on the bank immediately above the beach a little to the west of the wharf site, and just across the road from the Cabana flats, revealed a different assemblage of artifacts (basalt flakes, Classic Maori artifacts) from that of the wharf site (Shawcross 1964).

At the present day there are large quantities of soft shore shellfish on both estuarine and ocean beaches, in spite of intensive gathering by residents and holiday makers. In the muddy sands of the estuary are found cockles *(Chione*

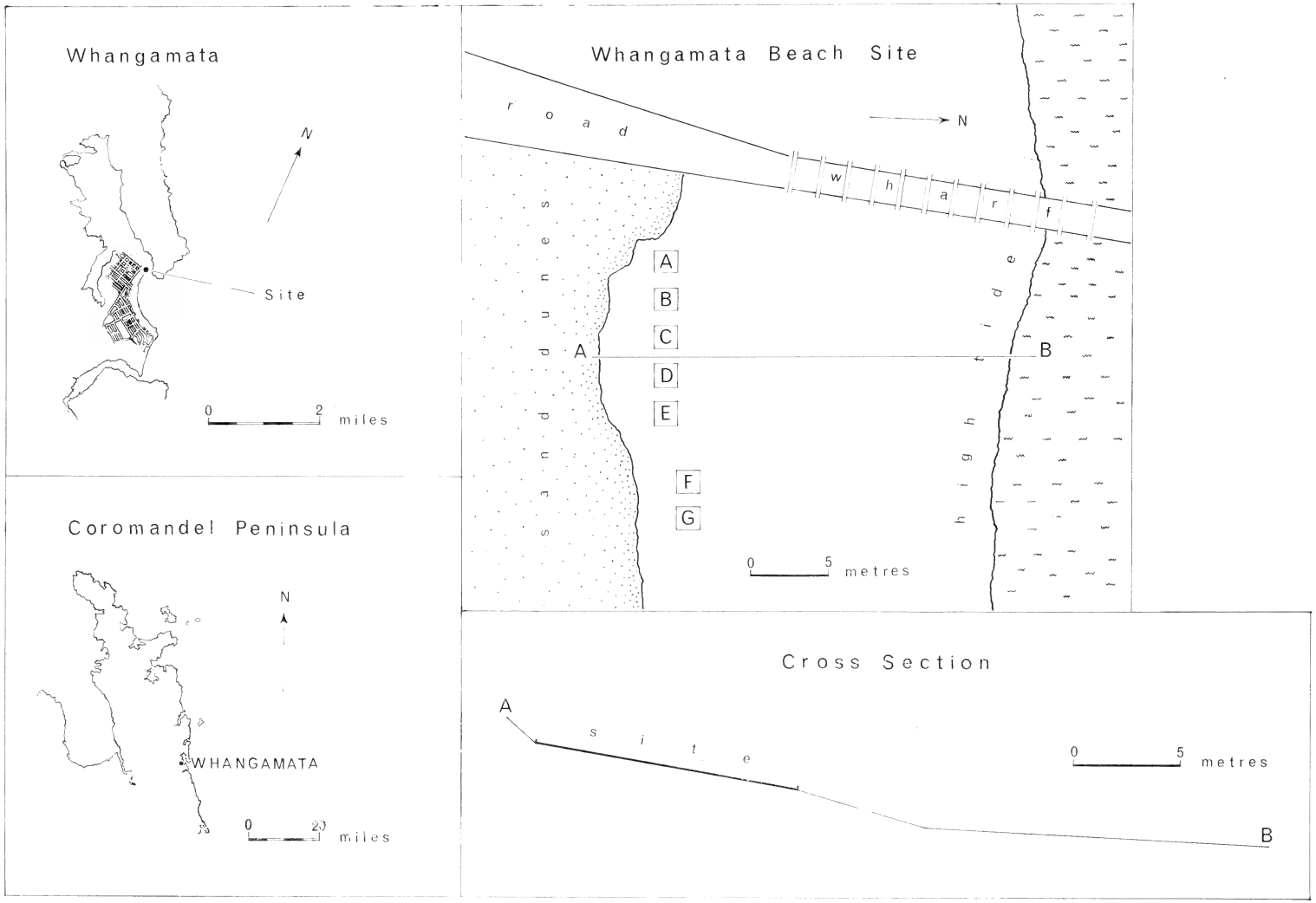
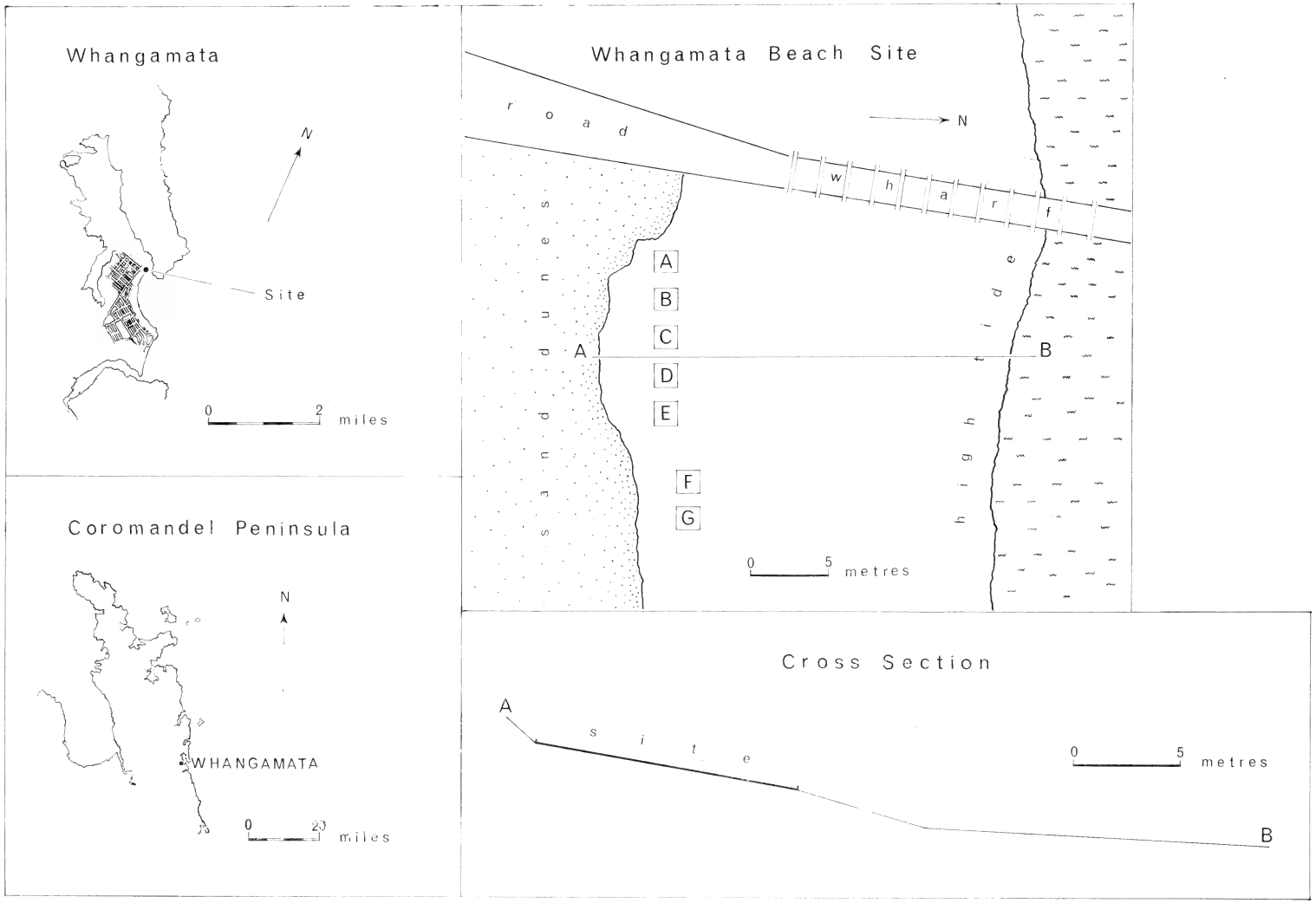


Fig. 1. Location and plan of the Whangamata wharf site, N49/2.



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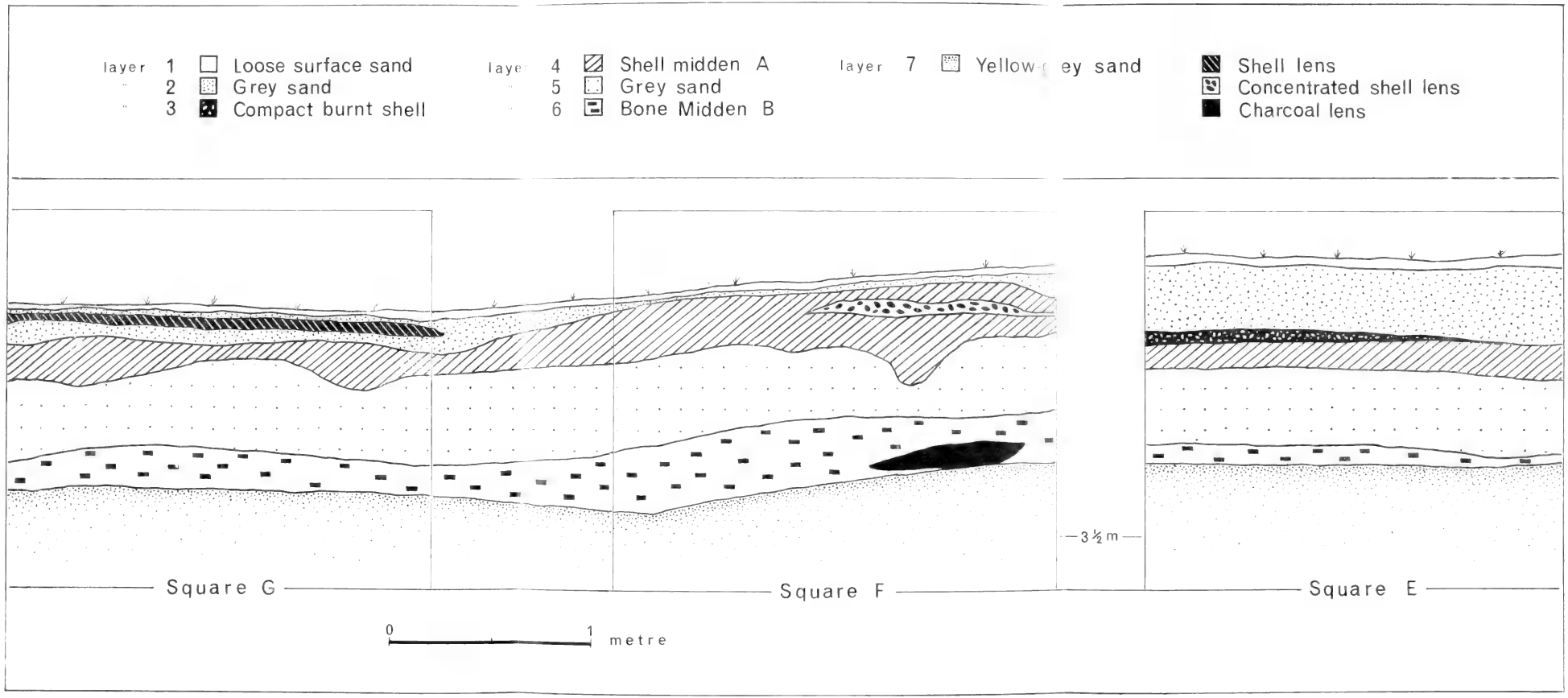


Fig. 2. Principal cross-section, N49/2.

stutchburyi) and pipi *(Amphidesma australe)* while the ocean beach is rich in tuatua *(A. subtriangulatum).* Since both estuarine and ocean beach shellfish are found in close proximity to the site, any marked preference for either type is presumably the result of cultural choice rather than environmental exigency. Beds of rock oysters *(Crassostrea glomerata)* and other gastropods are found on the rocky shore opposite the site.

Today there is no fresh water less than a mile from the site, except a permanent stream flowing into a waterfall at the cliffs on the other side of the estuary. Some of the older residents of Whangamata had heard descriptions of the early settlers rowing across the estuary to fetch fresh water. This may also have been true of Maori occupants, in early European times at least, since barrel hoops were found in the upper layer of the midden.

The excavation was restricted to the narrow strip between the high tide mark and the dunes which protect the foreshore from wind erosion. The excavation was set as far back towards the edge of the dunes as was practicable, to avoid the more eroded and thus disturbed area of the site closer towards the water. Seven 2 m squares were set out parallel to the edge of the beach. Squares A to E were separated by 1 m baulks. Squares F and G were slightly further forward and separated from the other squares by a gap of 3.5 m (Fig. 1). The squares were divided into quadrants. In this way it was hoped to localise, as far as was practicable, all bone and shell material. The site was excavated with hand trowels according to natural layers, and total collection of both bone and shell was carried out.

STRATIGRAPHY

The Whangamata wharf site contained two main occupation layers: a thick band of shell midden (termed Midden A) and beneath it, and separated from it by a metre of sterile sand, a second layer of midden (Midden B), containing bone rather than shell (Fig. 2).

Midden A was relatively homogeneous, although interspersed with *haangi* and in square G interrupted by a lens of sand. It contained intermingled European and Maori artifacts. The lack of any obvious demarcations within the midden seems to imply that it was formed during a single semi-continuous occupation of the site, dated (from the European evidence) at *ca.* 1870 (see p. 67).

In squares D and E an interesting hard trampled floor of shell, charcoal and sand (layer 3) lay immediately above Midden A. This was obviously a much-used area—possibly a centre of cooking activity, since there were several associated *haangi,* although there was no evidence of structures. There were no associated artifacts, thus only a *terminus post quem* of 1870 can be established. However, the apparent association of layer 3 with the traditional Maori way of life, and the fact that it lay immediately above Midden A with no intervening sand layer, make it probable that it too belongs to the nineteenth century.

Between layer 3 and the surface were small pockets of midden, without cultural associations and therefore of unknown date. Some at least may be of modern origin, and they are therefore not included in the site midden analysis.

Midden B contained the bone of an immature moa (probably *Euryapteryx gravis*), a one-piece fishhook, and an unfinished broken adze, apparently of Type 3 in Duff's (1956) classification. Midden B, therefore, appears to belong to the Archaic phase. Radiocarbon samples were collected from this layer but have not been submitted for analysis.

A 4 m deep test pit was dug in square D, extending nearly 2 m below Midden B, without revealing any further cultural remains. It would seem, therefore, that Midden B represents the earliest occupation of the site.

ARTIFACTS

FISHING GEAR

Two tabs made from whale rib were found in Midden A, both from the same square (D), immediately below a concentration of nails and glass. Both tabs suggest an early stage in manufacture of one-piece hooks. One showed gouging or "pecking" on the upper surface; the other was much larger and showed evidence only of preliminary shaping (Fig. 3).

Figs. 3, 4. Fishing gear, N49/2. 3. Bone tab, Midden A. 4. Fragments of one-piece fishhook from Midden B.

Pieces of an unbarbed one-piece fishhook with a flat-topped backward pointing head (Fig. 4) were found in Midden B (square A). There was some roughening of the inner surface of the shank, either very crude serrations or, as appears more likely, the marks of rat teeth.

The presence of a one-piece fishhook is consistent with other indications that Midden B dates from the Archaic phase. The whale bone tabs in Midden A seem to be anomalous, however, firstly because the manufacture of one-piece fishhooks (of which the tabs are a preliminary stage) seems to be rare in the Classic phase

(Hjarno 1967), and secondly because the presence of bone fishhook tabs seems inconsistent with the presence of 19th century artifacts, which were found in the same layer. However, the deep layer of sterile sand that lay between Middens A and B seems to preclude the movement of artifacts from one layer to the other. (There were no signs of artificial disturbance.) Midden A does seem to be fairly homogeneous, belonging to a single occupation period.

It is almost certain that European fishhooks were available to the Whangamata Maoris in the latter half of the 19th century. They were early introduced as trade goods, and were prized by the Maoris, although not as much as firearms and iron hoes and axes.

Marsden and his fellow missionaries were accustomed to taking fishhooks as well as other small articles on their journeys as presents for the Maoris, and Kendall wrote in 1821: "They esteem fish-hooks as equal in value to our copper, axes and hoes to our silver, and muskets and powder to our gold." (Elder 1934, p. 173).

Presumably, then, these tabs, apparently indicating traditional bone fishhooks, as well as the other Maori tools, were present in the midden either because of a certain conservatism among the Maoris which conflicted with the desire for more efficient and durable tools; or else because the Maori production of goods acceptable to European traders was insufficient to finance the complete replacement of Maori by European technology.

ADZES

The blade of a small rough-out (8.2 cm long) was found in Midden B, square F (Fig. 5). It seems to be of triangular cross-section with apex downwards (Duff's type 3). This type is uncommon in New Zealand sites.

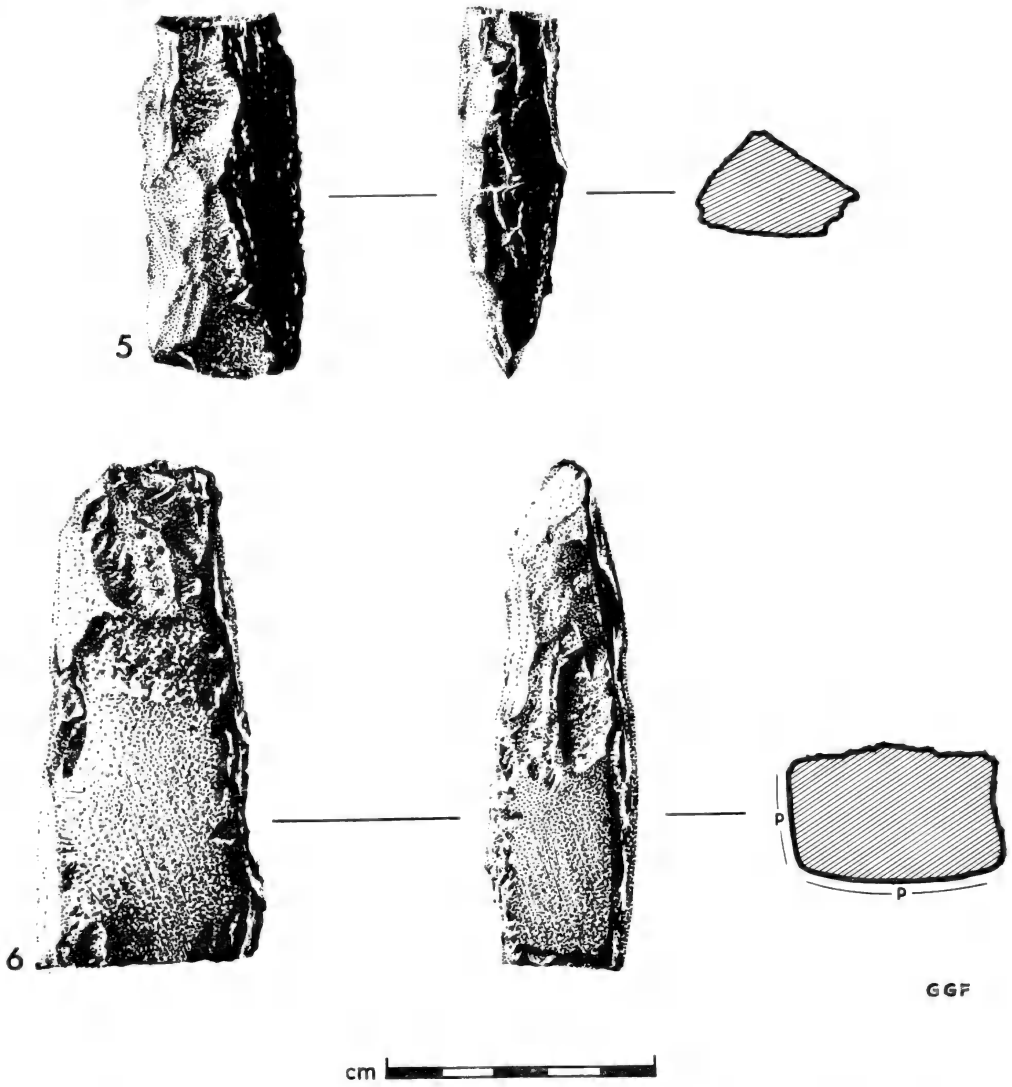
The butt of a larger adze was found in Midden A. It has a rectangular cross-section with very square cut sides, and narrows only slightly towards the poll. The front and sides are ground; the back is roughly flaked (Fig. 6).

FLAKES

Obsidian flakes were found in close association with scattered dog bones in Midden B. Figure 7, which shows the distribution of obsidian flakes, indicates clearly that most of them came from the Archaic layer. They are probably functionally connected with the dog bones, being used for butchering dogs or preparing their skins.

The flakes were measured (length = surface perpendicular to striking platform) and carefully observed for signs of use. It is evident from Figure 8 that flakes tended to be greater in length than breadth; in only 4 out of 86 was width greater than length. Thirty-one percent of the flakes had a length more than twice the width, while 7% had a width three times greater or more than the length. To what extent this tendency was the result of deliberate human action aimed at a particular template, and to what extent it was dictated by the nature of the material, is difficult to ascertain.

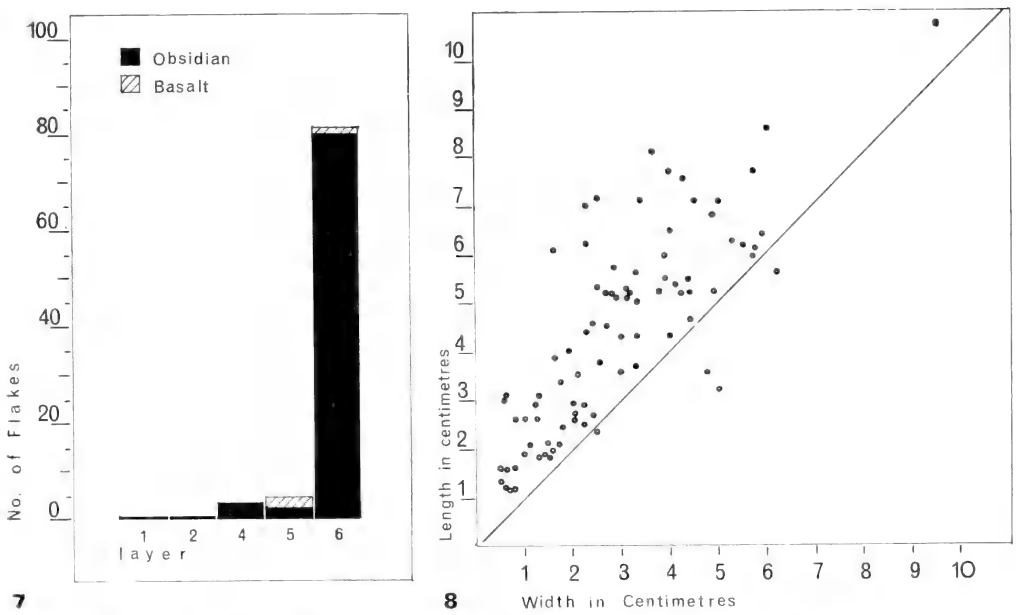
The presence of seven large cores, two quartzite hammer stones, and 171 tiny chips all less than 2 mm long, indicates that the flakes were prepared on the spot.



Figs. 5, 6. Adzes, N49/2. 5. Adze roughout from Midden B. 6. Butt of adze from Midden A.

A cache of obsidian flakes was found, containing 49 flakes and 3 cores; four of the flakes had apparently been used as end scrapers (shown by chipping and signs of wear on the relevant cutting edge), while ten flakes had been used as side scrapers. Of the flakes not in the cache three showed signs of use as side scrapers and two as end scrapers (Figs. 9 - 11).

Most of the obsidian in the site was of a dark grey colour, fairly opaque, with a greenish tinge, and is presumably from Mayor Island. Interestingly, however, the obsidian in the cache was not of this type, but was a clear grey colour with darker grey flecks.



Figs. 7, 8. Flakes, N49/2. 7. Distribution of obsidian and basalt flakes by layer. 8. Dimensions of obsidian flakes.

The presence of waterworn obsidian pebbles and boulders on the rocky shore opposite the site seems to indicate a hitherto unrecorded obsidian source (cf. Green 1964). This obsidian is grey and much of it contains spherulites. Some, however, is of flake quality, and some of the obsidian in the site may be derived from this source. In general, the local source would be capable of providing only small flakes, and obsidian for larger flakes would have to be sought further afield.

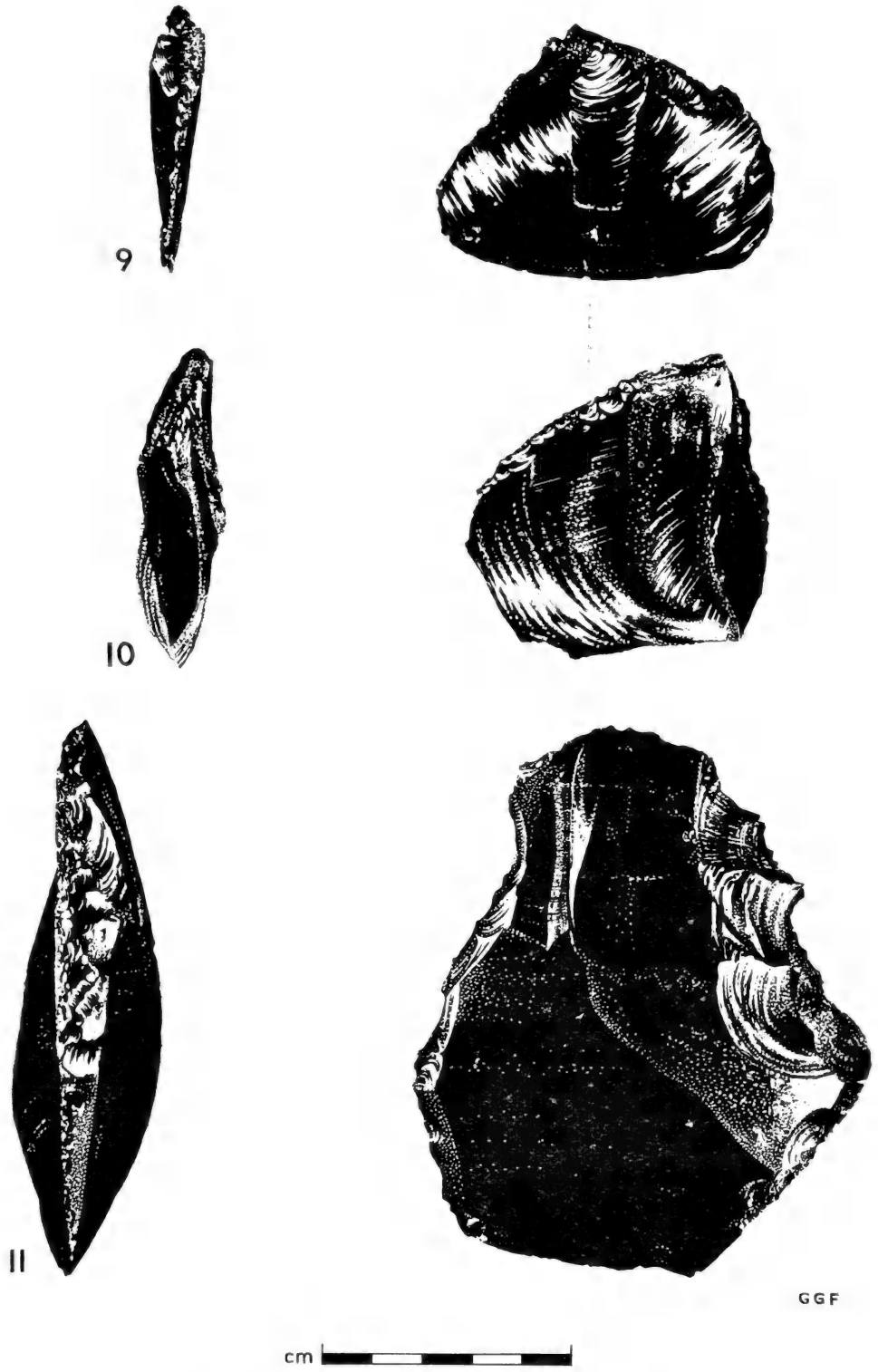
In contrast with many other middens on the Coromandel Peninsula, this site contained very few basalt flakes (Fig. 7).

EUROPEAN

A wide variety of European artifacts was found in Midden A and in the sandy layer between Midden A and the surface. Those within Midden A included pieces of melted lead (possibly reduced for sinkers), pipe stems, assorted iron and copper nails, beads, window and bottle glass, metal and pearl buttons and fragments of domestic earthenware and china. The last three categories obviously imply settled European residence at Whangamata, which in turn gives some indication of the age of Midden A.

Although the Coromandel Peninsula was a venue for trading and whaling ships from the early 1800s there are no specific records of such ships calling at Whangamata. An early record of Europeans at Whangamata is in the census report of 1876 which records the presence of 41 Europeans there, mostly employed at a small timber mill which was probably established some time between 1868 and 1876, in response to the Thames gold rush.

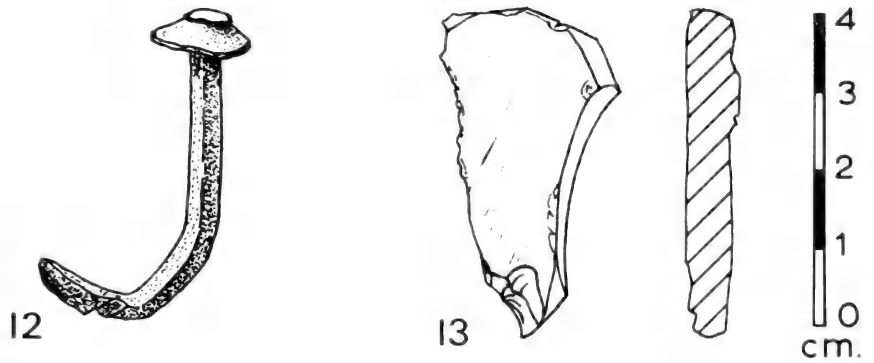
There was also a pipe stem in the midden which could not have been manufactured before the 1860s. On the other hand, there are no articles of modern manufacture; the bottle glass, for example, comes from hand-blown bottles.



Figs. 9-11. Scrapers, N49/2. 9. Obsidian scraper, Midden B. 10. Obsidian scraper, Midden B. 11. Obsidian scraper, Midden B.

OTHER

The use of European materials in the manufacture of traditional Maori implements is rare in New Zealand. Of particular interest, therefore, were four artifacts made from European materials. A bronze nail seems to have been bent into a fishhook shape and a barb cut at the point (Fig. 12). Three fragments of thick bottle glass, all about 4 cm long, seem to show deliberate flaking at one end, and in one case, also on the side. They were probably used as drill points (Fig. 13). These artifacts are consistent with the apparent association of European and traditional Maori artifacts in Midden A, implying a transitional stage where traditional Maori artifacts were still being made, but were in the process of being replaced by European goods and materials.



Figs. 12, 13. Artifacts from European material, N49/2. 12. Worked nail from Midden A. 13. Flaked piece of bottle glass from Midden A.

Midden Analysis

Only in the last few years of New Zealand archaeology has use been made of the knowledge that food debris in middens reflects just as much culturally determined human choice as the artifacts made by man. The study of midden material provides a description, not only of foods eaten and their relative importance, but also of the society which organised its economic activity to obtain these foods, and of the culture of which that society was a part.

The bone and shell material in the midden was therefore analysed, identified, and in order to gain a standard of comparison by which to establish the relative economic importance of different food, converted to approximate meat weights.

SHELL

Method of analysis

In processing the shell material, it was first sieved on the site, then, after being transported to the laboratory, dried and sieved again. The midden in each layer in each quadrant was then sorted into species and weighed.

A major problem in sorting the shell material was its extreme fragmentation. To facilitate the sorting of such a large quantity of midden (over 300 kg) only whole shells of the three main species or those fragments with a hinge were sorted

into species (Group A). The small number of gastropods and bivalves of other species were also classified into species. This left a large bulk of unidentified fragments without a hinge (Group B), all of which belonged to one of three species: *Chione stutchburyi, Amphidesma australe* or *Amphidesma subtriangulatum.* To project the species proportions of Group A fragments from a particular layer onto those of Group B would of course assume that the fragmentation rate of the three species was equal, which would probably not be true, since *Chione* has a more delicate shell than *Amphidesma.*

Thus to establish the rate of fragmentation of *Chione,* as opposed to *Amphidesma,* the total midden material from three quadrants of Midden A (from each end and the middle of the site) was sorted into Group A or Group B fragments, and within these groups into *Amphidesma* and *Chione.* The difference in species proportions between the two groups presumably reflects different rates of fragmentation. Results are shown in Table 1.

Table 1. Fragmentation of *Chione* and *Amphidesma* in three quadrants of Midden A.

QUADRANT	GROUP A			GROUP B			
	Chione (g)	*Amphidesma* (g)	ratio	*Chione* (g)	*Amphidesma* (g)	ratio	DIFFERENCE
A1	4755	2288	48:20	1825	415	88:20	2.1
C4	575	577	20:20	1863	718	52:20	2.4
G1	550	715	15:20	3425	1825	38:20	2.5

It can be seen that the difference in the ratio between Group A and Group B fragments is fairly consistent, indicating that *Chione* disintegrated at a uniform rate of approximately 2.4 times the rate of *Amphidesma.* Thus the Group B fragments were divided into species according to the following ratio.

If weight of Group A fragments *Chione* = X
And weight of Group A fragments *Amphidesma australe* = Y
And weight of Group A fragments *A. subtriangulatum* = Z
Then Group B fragments = 2.4X : Y : Z.

After the weights of each species for each layer were established, the results were reduced to percentages of the total weight, to find the relative importance of each species in the prehistoric economy. Obviously this was of great importance in a site such as Whangamata, where two separate marine environments were available to the inhabitants.

Results

Nearly all the shell (99.4%) came from Layer 3 (8%) and Midden A; there was almost no shell in Midden B (0.6% of total).

Figure 14 shows the relative distribution (by weight) of the shell species in Layer 3, Midden A and Midden B (omitting the shell lenses above Layer 3, of uncertain age). It is obvious that throughout the occupation of Whangamata, estuarine shellfish were preferred to those of the rocky shore or ocean beach. The lack of rocky shore shellfish is to be expected, since their collection would involve a canoe trip to the other side of the estuary. In any case, even if such voyages

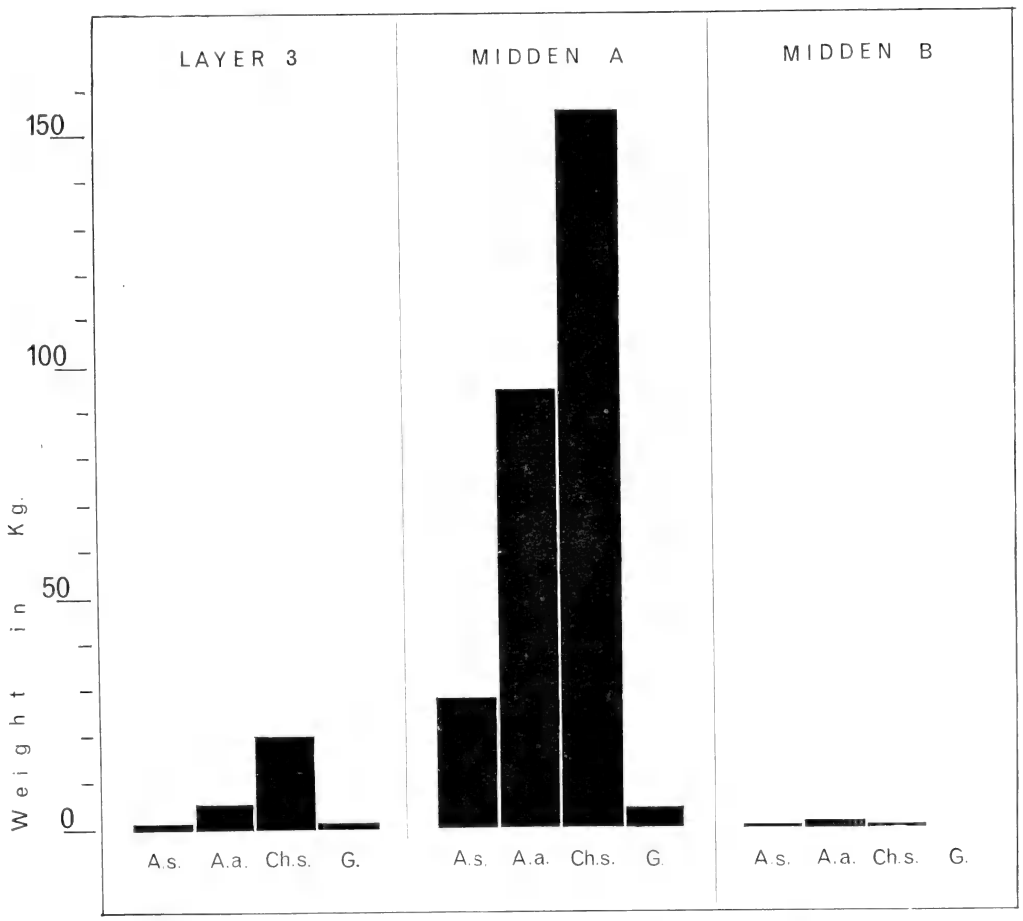


Fig. 14. Species distribution of shell by weight, N49/2.

were frequent, the heavy shells of rock oysters *(Crassostrea glomerata)*, at least, and perhaps of large rock gastropods, would probably have been left on the spot where they were gathered, and thus would not be represented in the midden. The few gastropods and rock oysters present in the midden are probably the result of occasional voyages to the other side of the estuary for fish or fresh water.

The relative scarcity of *Amphidesma subtriangulatum* is rather more difficult to explain, since they are present near the site today in large numbers. Presumably the supplies of estuarine shellfish were adequate to fulfill economic demand, and either because of flavour or easier access were preferred to those of the ocean beach.

Since the later inhabitants of the site almost ignored a rich and readily available source of food in the ocean beach shellfish, there would seem to have been no shortage of protein foods among them. The same was presumably true of the Archaic Maoris, who made almost no use of shellfish for food.

In discussing prehistoric diet in a New Zealand midden site Shawcross, on the basis of modern shellfish samples, estimated the proportion of shellfish meat

to shell weight as being approximately 32.5% (Shawcross 1967, p. 121)[1]. Table 2 shows the results of applying this percentage to the Whangamata shellfish.

Table 2. Weights of shellfish.

	SHELLFISH	Shell Weight (g)	Calculated Meat Weight (g)	Percent
Layer 3	*Amphidesma australe*	3984	1295	16
	A. subtriangulatum	636	207	2
	Chione stutchburyi	19495	6336	79
	gastropods	683	222	3
	Total	24798	8060	100
Midden A	*Amphidesma australe*	91820	29842	34
	A. subtriangulatum	27147	8823	10
	Chione stutchburyi	147550	47955	54
	gastropods	4723	1535	2
	Total	271240	88155	100
Midden B	*Amphidesma australe*	1055	343	63
	A. subtriangulatum	431	140	26
	Chione stutchburyi	191	62	10
	gastropods	0	0	0
	Total	1677	545	100
Total meat weight of shellfish on site			96.76 kg	

BONE

Fish

Surprisingly (since Whangamata today lies near a good fishing ground) there were few fish bones found in the midden—a total of 30 bones representing a minimum number of six fish. They consisted of the following species.

Snapper *(Chrysophrys auratus)*	3 individuals
Trevalli *(Usacaranx lutescens)*	1
Porae *(Cheilodactylus douglasi)*	1
Unidentified	1

All these came from Midden B; there were no fish bones in the upper layers. The approximate weight of the fish was calculated according to the following formula (for derivation see Shawcross 1967, Allo 1970b).

lx = dentary length (midden material)
Lx = unknown length of fish (midden material)
ls = dentary length (comparative material)
Ls = known length of fish (comparative material)

[1] Properly applicable only to *Amphidesma australe*, but differences in proportion of meat weight in *Chione stutchburyi* and *Amphidesma subtriangulatum* are probably not great.

$$(Lx)^{2.69}/(Ls)^{2.69} = (Wx)/(Ws)$$
$$\therefore Wx = (Ws.lx^{2.69})/(ls^{2.69})$$
$$\therefore Wx = Ws(lx/ls)^{2.69}$$

Using this formula, the combined weight of the trevalli and snapper was calculated to be *ca.* 5.36 kg. The weight of the porae could not be calculated, since the dentary was not present in the midden. A porae of average size in the comparative collection, however, weighed 2.1 kg. The unidentified fish, which appeared to be of approximately the same size, was assumed to be approximately the same weight. A rough estimate of the total weight of fish in Midden B therefore is 9.56 kg. If it is assumed that 90% of this total was edible meat (the Maori probably ate the guts of the fish, cf. Shawcross 1967) the bones from the midden appear to represent a total edible fish meat weight of 8.6 kg.

Bird

Seven species of bird were found in Midden B. These were mostly sea birds, but one example each of the bush-dwelling kiwi and tui were also found. No bird bones were found in Midden A. The distribution of species and minimum number of each present were as follows.

Moa (juvenile, probably *Euryapteryx gravis)*	1
Shag	3
Duck	1
Kiwi	1
Tui	1
White Heron	1
Blue Penguin	1

An attempt was made to estimate the amount of edible meat represented by the bird bones in the midden, using the live weights of birds of approximately the same size (White 1953, weights converted to kilograms). Results are given in Table 3.

Table 3. Weights of birds in Midden B.

SPECIES	EQUIVALENT (White 1953)	No. of individuals	Live weight (kg)	% edible meat	Weight edible meat (kg)
Shag	small goose	3	6.75	70	4.72
Duck	small wood duck	1	0.68	70	0.48
Kiwi	small goose	1	2.25	60	1.35
Tui	woodcock	1	0.21	70	0.15
White heron	small goose	1	2.25	70	1.57
Blue penguin	small wood duck	1	0.68	60	0.41
Juvenile moa	trumpeter swan	1	25.00	60	15.00

Live weights therefore total approximately 37.82 kg. White has estimated that 70% of a live bird's weight consists of edible meat. This proportion, however, does not apply to flightless birds, such as the penguin or moa, whose bones are proportionately heavier. It can be estimated that *ca.* 60% of the live weight of a flightless bird consists of edible meat. The total amount of edible meat represented by the bones from the midden, therefore, is approximately 23.68 kg.

Dog

There were 172 dog bones in the Archaic layer, representing a minimum number of 17 dogs. A further seven bones, probably belonging to a single dog, were found in Midden A.

The bones were lying thickly in a fairly limited area, and scattered among them were obsidian flakes, including a cache of 49 flakes and 3 cores. It is likely that there was some functional connection between the flakes and the dog bones, since 171 minute chips, indicating use or re-chipping of flakes on the spot, were found scattered over this area. The flakes may have been used for butchering the dogs (although there were only a few signs of cutting on the bones) or for the removal or preparation of skins. A large proportion of the flakes showed signs of wear on one or more cutting edge.

There were no pathological abnormalities evident in the bones, and only a few congenital abnormalities, mostly dental. Two right mandibles contained a supernumerary alveolus behind the third molar, indicating either that M_3 had an additional tooth root, or that there was a small single-rooted M_4. This is a fairly common dental abnormality in the Maori dog, being found in at least twelve other sites scattered all over New Zealand, including one site (Native Island) at Stewart Island.

The feature of additional alveoli (usually found behind the last molar, but sometimes also among the premolars) is in fact peculiar to the Maori dog. Crawford, for example, in his study of modern dog dentition (1937, p. 216), wrote:

> "In the dolichocephalic breeds it might be expected that there would be more supernumerary teeth because of the greater length of the jaws. This has not been the case in our observations. Rather the teeth are more widely spaced with exposed gums between, especially in the pre-molars. The dental formula for this type apparently runs true to form."

It must be emphasised that the presence of supernumerary teeth is not a normal feature of Maori dog dentition (it was found in only 7% of North Island Archaic mandibles, and less than 1% of South Island Archaic mandibles) but where it is found on a site it is usually relatively common — 38% of the 18 Redcliffs mandibles possessed a supernumerary M_3 alveolus, for example, as did 43% of those from Jacksons Bay. The Whangamata percentage of mandibles with supernumerary alveoli (only 5%) was unusually low.

Two other mandibles were congenitally abnormal. A left mandible possessed a small single-rooted P_4 (the fourth lower premolar usually has two roots) and in another mandible fusion of the two roots of M_2 into a single tooth root had taken place.

There was also a congenital abnormality present in the body skeleton. Three out of sixteen humeri (one left and two right) lacked a supratrochlear

foramen: a thin layer of bone lay between the olecranon and coronoid fossae. This feature is uncommon in the Maori dog: a single example was found at both Heaphy River and Wairau Bar, but these are the only other examples known. Its rarity implies that it is acquired during life (for example as a result of lack of exercise) rather than genetically transmitted. It is common in several breeds of modern dog, and does not involve functional disability.

In a study of the Maori dog (Allo 1970a) it was found that throughout New Zealand prehistory the dog was important as a food animal. Out of a minimum number of 335 dogs from sites all over New Zealand, only two were found articulated and nearly complete. The rest of the bones were widely scattered over the sites, indicating that they were dismembered for eating. The removal of the posterior part of the cranium, presumably for the extraction of the brain for eating, was a common feature on all sites, being found in 169 out of 204 crania (83%). The skull of the dog is very strong, and unlikely to split cleanly in half across the parietals by accident, especially since the breakage did not follow a cranial suture. On some skulls there was even a clear indication of a heavy blow, probably made by a stone, on the supraoccipital or right parietal. The relatively few cuts found on the bones indicate that the dog was cooked whole rather than dismembered immediately after slaughtering. A few bones, both at Whangamata and at other sites, do bear shallow cuts. These cuts, nearly always on the long bones, may have been made in butchering the animal, or as a preliminary stage in manufacturing a bone artifact.

Only a few bones at Whangamata were carbonised. Since the Maori in both Archaic and Classic phases, used the *haangi* or earth oven where the food is cooked by hot stones and never comes into direct contact with fire, the burning of the bones is probably not a result of cooking, but is accidental.

The archaeological evidence that most Maori dogs were eaten after death is well supported by ethnographic evidence. There are several descriptions of the dog as a food animal. Crozet, for instance, who gave one of the first descriptions of the Maori dog, wrote in 1772 (Crozet 1891): "It appears that the savages only raise them (dogs) for food." The elder Forster in 1778 commented (Forster 1778 p. 189): "They (dogs) are kept by the natives chiefly for the sake of their flesh, of which they are very fond, preferring it to pork."

It is a reasonable assumption, then, that the Whangamata dogs (none of which was found articulated) were used as food animals. It is interesting to define the economic importance of the dog in this site as a source of food.

Of the 17 individuals found, four were juveniles aged less than seven months. It was possible, by a study of their dentition, to date the juveniles accurately: the youngest was aged approximately 5 months, two were aged 5 to 6 months, and the fourth died at the age of 6 to 7 months. The remaining dogs probably died when they were over 18 months old (only 9 bones with unfused epiphyses were found, representing a minimum of 4 individuals less than 18 months old).

By comparing the average condylo-symphisis length of the left mandible, the most frequent intact bone of the Whangamata dogs, with that of a comparative collection of known weight and size, it was possible to compute the approximate body weight of the Maori dogs.

Since the Maori dog had disproportionately short legs in relation to head size, the calculated weight is probably slightly too large. However most of the weight of an animal is distributed in the head and trunk rather than in the limbs, and disparity should not be too great. The dogs of the comparative collection on which weight estimates were based were all rather thin, as probably was the Maori dog.

In computing body weight, the following formula was used, based on an assumed increase in body weight proportionate to the cube of a linear increase in body size.

If W = known weight of comparative material
And Ws = unknown weight of sample
And if L = average length of mandible of comparative material
And Ls = average length of mandible of sample

$$\text{Then } Ws = \frac{W \times Ls^3}{L^3}$$

Using this formula, the average weight of the adult Whangamata dogs was 12.65 kg. The average weight of the juveniles was estimated to be four-fifths of this total or 10.11 kg. The total weight of the dogs at death came to approximately 204.98 kg.

Obviously this weight is far greater than the weight of the edible meat. In his study of the utilisation of food animals by prehistoric peoples, Theodore White has estimated that 50% of the live weight of fox, coyote and wolf was usable meat. If this proportion is accepted for the Maori dog, then the skeletal remains at Whangamata represent approximately 102.5 kg of dog meat.

HUMAN

Burnt and scattered human bones, representing a single individual, were found scattered among the dog bones of the Archaic layer, and are probably evidence of cannibalism.

The bones were those of an adult, but were so fragmented it was impossible to estimate sex or size. If it is assumed that the individual weighed *ca.* 63.5 kg (10 stone), and that, as with dog, deer and bison, 50% of the total weight of the human animal consists of edible meat, then the single skeleton represents approximately 31.7 kg of meat.

Table 4. Weights of mammals other than dog, man and whale.

	ANIMAL	Average live weight (kg)	% edible meat	Weight edible meat (kg)
Midden A	Rat	0.35	70	0.24
	Rabbit	1.58	50	0.79
	Fur Seal	180.00	70	126.00
	Total			127.03
Midden B	Fur seal (2)	360.00	70	252.00

OTHER

Bones representing a minimum number of two seals (probably the Southern Fur Seal) were found in the Archaic layer, as was the vertebra of a whale. A single seal bone, the ulna of a rabbit, bones of a *kiore* (native rat) and pieces of whale rib were found in Midden A. The total live weight and amount of edible meat represented by these bones is given in Table 4 (the whale(s) omitted).

Conclusions

Since only twenty-eight square metres were excavated in a site of unknown extent, any conclusions must of course be tentative. However it seems that two

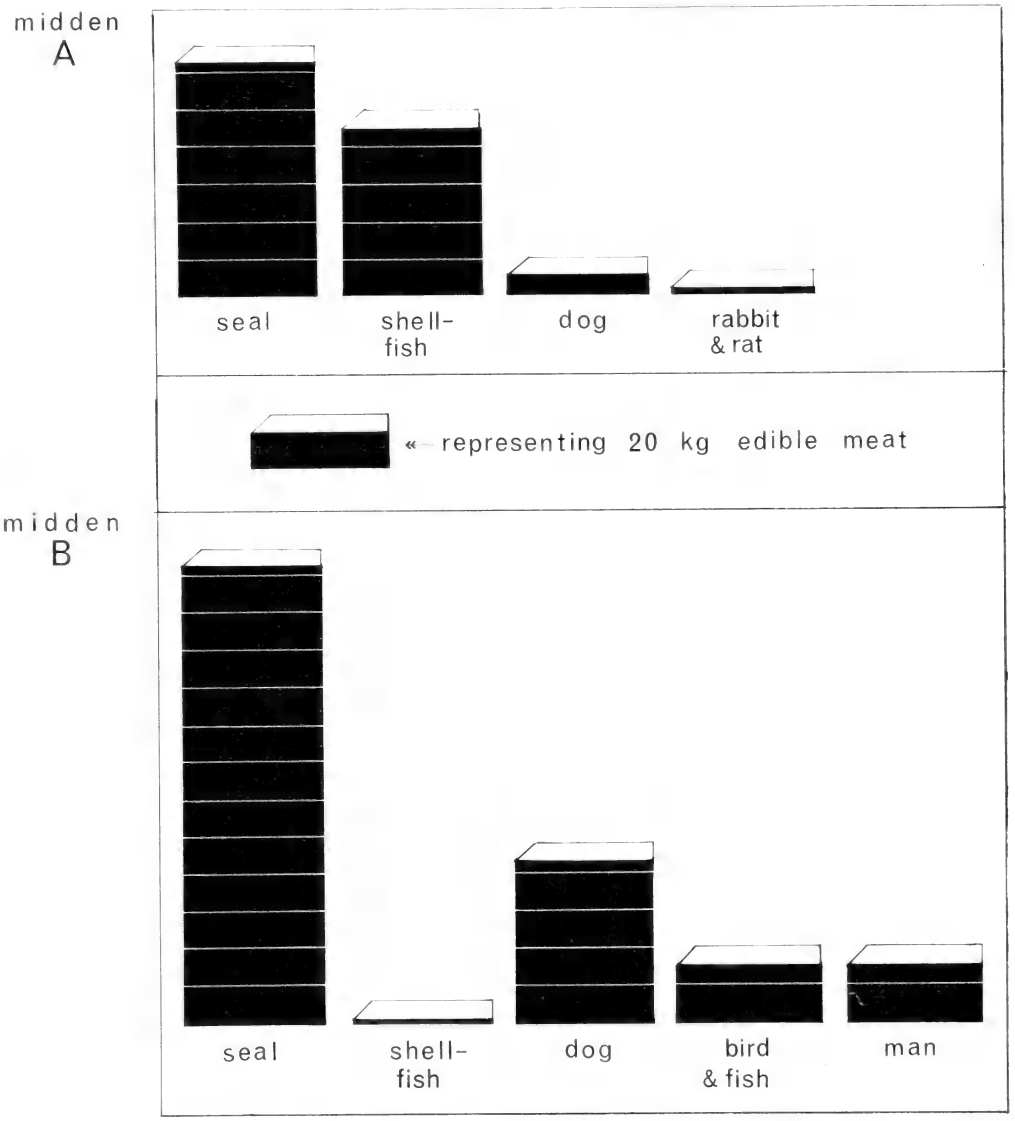


Fig. 15. Calculated meat weights, Middens A and B, N49/2.

main occupation periods are represented at the Whangamata wharf site, during which widely different use was made of available food resources. These differences are illustrated in Figure 15.

During the Archaic phase (Midden B) the inhabitants of the site almost ignored the readily available supplies of shellfish, and instead obtained their protein mainly from seal and dog. The absence of shellfish in Archaic middens is a common phenomenon in New Zealand (e.g. Lockerbie 1959) and it has been postulated that the Maori only turned to marine sources of food as a result of the extermination of the moa (Lockerbie 1959, Simmons 1969). At Whangamata moa would seem to have been relatively unimportant; seal and dog were the major protein foods. It may be that an increasing dependence on shellfish foods in many areas during the Classic phase was due to a complex of causes rather than simply to scarcity of moa.

The dog seems to have been a major food animal during the Archaic phase of Whangamata. This contrasts with observations from early explorers in New Zealand that the dog was a rare and much prized delicacy (e.g. Forster 1778, p. 208; Cruise 1824, p.270) and with archaeological evidence that the dog was comparatively rare during the Classic Maori phase (Allo 1970a, chapter 5).

The more recent occupation levels of Whangamata (Midden A and Layer 3) seem to represent a transition between the traditional and European ways of life. Maori artifacts (obsidian flakes, whalebone tabs and an adze) were found intermingled with European goods in Midden A, apparently dating from the latter half of the nineteenth century, and Layer 3 is probably fairly closely related in time. Shellfish were the major source of food; in contrast to the Archaic period, no use was made of fish or bird resources and only one dog was found in the midden.

Acknowledgements. Permission to excavate the site was given by the Thames County Council, who were most co-operative throughout the dig. Financial assistance was provided by the Auckland Institute and Museum. Two of its staff members were particularly helpful, Dr R. C. Cooper who at the expense of a broken axle transported the excavators and nearly half a ton of midden back to Auckland, and Miss Janet Davidson who made the initial arrangements and was unfailing in her help and encouragement. Illustrations were drawn by Mr G. Farrant (Figs. 3-6, 9-11), Mr K. M. Peters (Figs. 13-14) and Mr A. P. Alexander. I should like to thank Mr and Mrs East of the Cabana Lodge Flats, Whangamata, for their hospitality, and the excavators themselves, several of whom assisted not only in the excavation but in the laborious task of processing the midden afterwards.

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ARCHAEOLOGY AT HARATAONGA BAY, GREAT BARRIER ISLAND

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Abstract. The archaeological excavation of three small prehistoric Maori sites situated in a small bay on Great Barrier Island, New Zealand, is described, and the results of the analysis of the excavated material are presented. The sites comprise a beach midden dating from about the 13th century A.D., a second beach midden, and a fortified site, both of which are later in time. The data from the three sites when compared show changes in the frequency of use of fish, birds, mammals and shellfish, and changes in the individual species used in each group. Changes in the raw material used for tools also took place and the different character of the sites indicates changes in settlement pattern.

Great Barrier Island lies in the mouth of the Hauraki Gulf off the north east coast of the North Island of New Zealand. It is 20 miles (32 km) long, lying roughly north to south, a maximum of 12 miles (19.3 km) wide, and some 74,000 acres (299 km^2) in area. It is very rugged, rising to 2,038 ft (621.1m) at its highest point. Much of it is still forested. Considerable milling of kauri *(Agathis australis)* and other timber has taken place since European settlement but only a little of the island is under farm. These farms are at the heads of the harbours on the west coast and behind the bays on the east coast. Extensive areas of fire-induced vegetation also occur, some probably pre-European in origin like similar vegetation on other off-shore islands (Cochrane 1957, p.38). As a result of the limited pastoral development the population of indigenous birds is still substantial.

Geologically the island consists of a small area of undifferentiated greywacke in the north and around Harataonga Bay in the east with more recent volcanics elsewhere. The soils derived from these materials are fertile. Obsidian is associated with the acid volcanics, and, although no quarry sites have yet been found, this resource was almost certainly used by the prehistoric Maoris for flake material (Green 1964, p. 140; Green *et al.* 1967). Figure 1 shows the areas of acid volcanics on the island, both of which contain obsidian (Spring-Rice 1962; N.Z. Geological Survey 1960). Most of the flake-quality obsidian from the Ahumata source so far inspected is relatively clear smoky to grey colour in transmitted light. Some decidedly inferior green obsidian does occur in the Awana Stream source.

Natural food resources are abundant. The surrounding sea is regularly trawled and a whale fishery existed on the island irregularly in production till the 1950s. Sea birds are numerous (Bell & Brathwaite 1964) as are land birds. The east coast beaches, estuaries and rocky shores are ideal for shell fishing. The island was connected to the mainland during the last glaciation, so potentially all the flightless fauna of New Zealand should occur.

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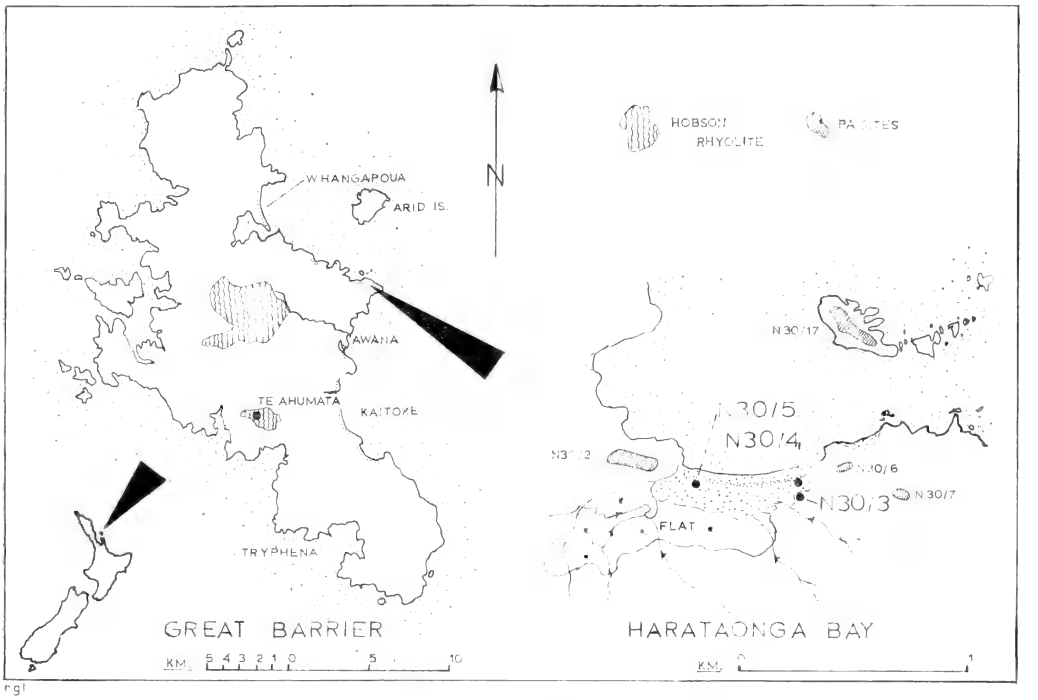


Fig. 1. Location maps, Harataonga Bay and the excavated sites.

Because of the difficulty of access little is known of the field archaeology of the island. Pa seem to be rare on the west coast, but quite numerous on the east coast, where beach middens sufficiently rich to attract fossickers also occur.

The sites described in this report were discovered by Mrs W. Spring-Rice (Spring-Rice 1962). Her survey covered the area around Harataonga Bay, a small sandy bay with a northerly aspect, fringed by rocky coast and sheltered by two small islands. As Fig. 1 shows, pa are a dominant feature of the bay, although some undefended pit sites occur on the ridges. Midden is virtually continuously exposed along a high sand ridge backing the beach. Behind the beach is a flat area of alluvial soil. Behind this again the hills begin.

The area was selected for further investigation for several reasons. The site survey had already revealed the existence of a very small defended site close to a midden suitable for the testing of various excavation and sampling techniques. The bay was within reasonable distance of the areas where obsidian reportedly occurred and these could be visited by small parties during the investigations. Finally the Royal New Zealand Naval Volunteer Reserve had generously offered to transport a field party to what was normally an inaccessible area.

At Easter 1962, accordingly, a party of 32 members of the Auckland University Archaeological Society was ferried to Harataonga Bay by an RNZNVR launch and commenced excavations under the direction of Dr R. C. Green and

Mrs W. Spring-Rice who made the field notes used in this report. The author was not present at the original excavations but has since had the opportunity to inspect the sites concerned in detail. Pressure of work had prevented the excavators from completing the analysis of the material recovered, and the invitation to the author in 1969 to complete the analysis and write the report is gratefully acknowledged. A preliminary report has appeared (Spring-Rice 1963).

As the excavations took place on three different sites which yielded very diverse results it is proposed to discuss each site separately, starting with the site which is apparently the oldest. The concluding section will attempt to correlate the three sites.

The Western Midden N30/5

This site consisted of an eroding area of midden, the top of which was about 1 m above high tide level. The deposit formed a bank at the top of the beach and after a short length of exposure disappeared under the dunes behind the beach (Fig. 2). Excavation of this site was not part of the original field programme. Its potential was recognised by Messrs R. G. W. Jolly and R. Sunde who drew it to Dr Green's attention and a small excavation took place, to place on record another Archaic site, to test theories about the order

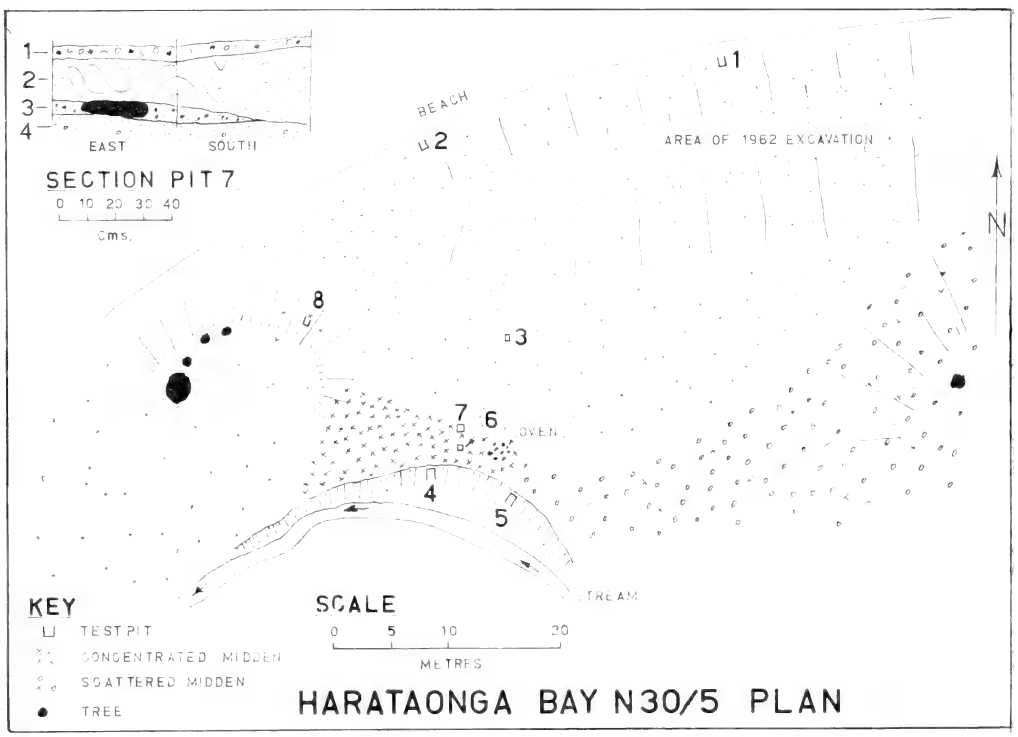


Fig. 2. Site plan N30/5, the western midden.

of exploitation of local obsidian resources, and to compare the economy with that excavated at another island site, on Motutapu Island (Pig Bay, N38/21) where despite an Archaic dating moa was unimportant.

A grid of three metre interval was aligned along the midden exposure and three 2.5 m squares were excavated within the grid in a line parallel with the beach. In addition, some material was recovered from the exposed seaward area of the site. With three sites being excavated concurrently in the bay, this site received less attention. However, the excavations recovered a wealth of material which makes worthwhile closer analysis of the data.

Part of the area excavated was stratified. An upper layer was recognised in squares B 1 (the eastern-most) and B 2. This, like the lower layer, consisted of diffuse midden. In square B 2 the upper layer included an oven and an adjacent lens of clay which must have been imported to the site. The upper layer was separated from the lower by up to 20 cm of clean sand. Material from these two squares, but not the baulk between was separated stratigraphically on excavation. In square B 3 the dividing layer was no longer present and only one layer was recognised. Lacking an internal division, it cannot be correlated precisely with either one or the other of the layers in the two adjacent squares. In consequence only part of the excavated material is stratigraphically divided.

In a brief visit to Harataonga in 1969, the author concentrated on this site. Figure 2 shows the general setting of the excavation to be reported in this section as it appeared in 1969. The area to the north of the small stream appears to be an extension of the area excavated. There has been considerable wind erosion here and midden material is exposed on the surface. This consists of an oven, a considerable quantity of small bird bone, a little moa in industrial waste, some shell and a considerable quantity of obsidian all of which was from Mayor Island. The obsidian seemed subjectively to consist of larger flakes than those from the excavation, several of the flakes being over 6 cm in length. A piece of the butt end of a reversed grip triangular sectioned adze was collected from this site. Several test pits were sunk but all except No. 7 showed only a thin surface layer resting on sterile sand. The section found in pit 7 is shown on Fig. 2. The stratigraphy was as follows:

Layer 1: Sand, grey with inclusions of shell, bone, pumice and obsidian.

Layer 2: Mottled, silt clayey light grey, and sand clayey grey-brown with inclusions of charcoal, shell, fishbone and siliceous flakes.

Layer 3: Flat rounded beach boulders in a matrix of grey-brown sand with an inclusion of a piece of the mineral asbeditis.

Layer 4: Brown sand, sterile except for several pieces of pumice.

The collection of pumice from layer 4 was identical to the pumice from the excavation but the surface material was sand-blasted, and probably from a source outside New Zealand (Wellman pers. comm. 1969).

This section and the rest of this area compare closely with the excavated area. With the importation of boulders and soil it appears some undefined construction has taken place on the site. In these circumstances the layer of sterile beach sand encountered in squares B 1 and B 2 of the excavation need not represent the passage of a significant interval of time between the deposition of the layers. None of the test pits elsewhere in the site suggests more than a single occupation. Moreover, where the excavated material can be divided into two stratigraphical groups, they show few differences. Data are available for bird, fish and mammal bone and for the artifacts. The small sample of shell was not suitable for subdivision. Both artifact assemblages are Archaic. The associated faunas are nearly identical. In view of the above, presentation of the data here is as for a provenly single period assemblage. This has the advantage of clarity and creates a larger pool of data for external comparison.

The provenances of the figured artifacts are noted in the figure captions. Unfigured artifacts include from the upper layer of squares B 1 and B 2, two roughouts, a fishhook core and a drill point, while from the lower layers are three fishhook pieces and two cores, a drill point, and two pierced *Glycymeris*.

The other stratified material from squares B 1 and B 2 is as detailed below with the upper layer first under each item. Mayor Island obsidian flakes, 18 (2.4 g average), 17 (3.3 g average), other obsidian flakes, 3, 2, Basalt and greywacke flakes, 105 (9.2 g average), 119 (5.2 g average), Siliceous flakes, 41 (5.9 g average), 12 (6.5 g average), Pumice pieces, 1, 21.

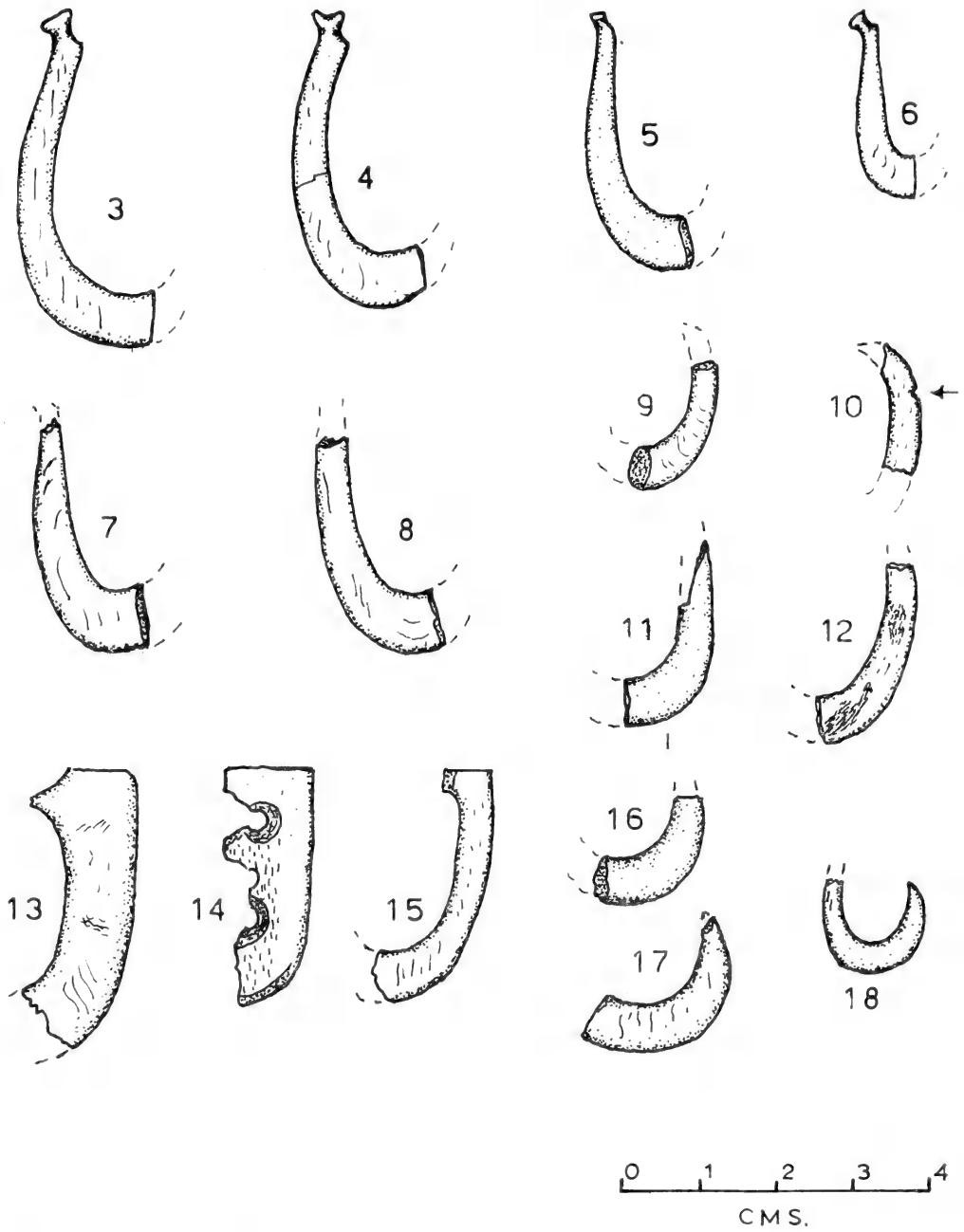
The only stratigraphic variations which may have significance are, the concentration of pumice in the lower layer, and the larger size of basalt and greywacke flakes in the upper. Data on the provenances of the faunal material has been included in tables.

ARTIFACTS

Fishhooks and lures

In all, 13 fragments of finished one-piece hooks were recovered (Figs. 3 - 18). The shank leg pieces, clearly the result of breakage in use, demonstrate the form of simple line attachment. The five fragments of unfinished hooks, of which three are illustrated, define the character of the other leg of the one-piece hooks. Only one complete point was found (Fig. 10) but this shows a characteristic bait notch on the outer edge. Two other pieces seem to be from hooks lacking an inturned point (Figs. 17, 18).

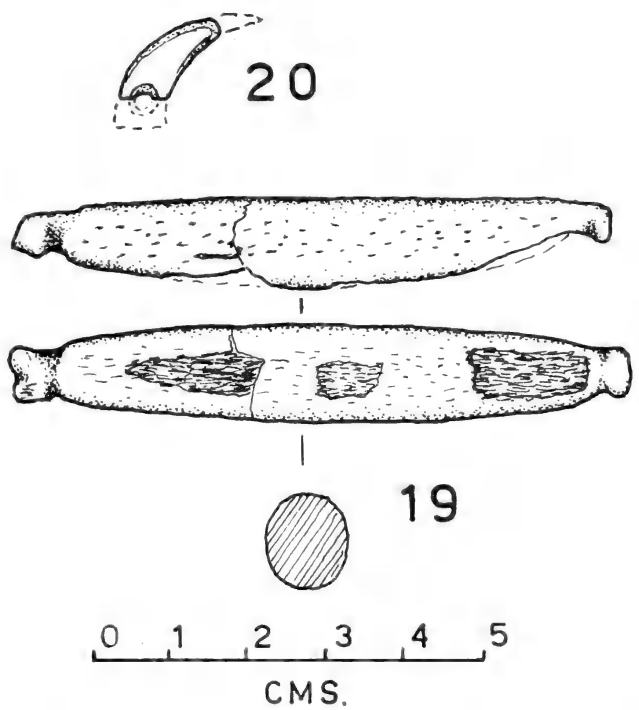
The first type of hook, one-piece with an incurved point, is in every respect identical to Crosby's Opito I variety (Crosby 1966, p. 187) which is characteristically found in large number in early sites in the north of the North Island (Nicholls 1964, p. 33 - 34; Golson 1959, p. 45; Roe 1969, p. 22). The second form with a shorter point leg, lacking the inturned point, conforms to Crosby's Opito II variety (Crosby 1966, p. 191) which is usually in association with the I variety. Crosby suggested this form is a broken and re-used Opito I hook. The material used for all these hooks but one appears to be moa bone, the remaining hook being apparently of ivory.



Figs. 3-18. Fishhook pieces from N30/5. 3, 11. Baulk B2-B3. 4, 5, 6. Surface. 7, 14. Square B1, upper layer. 8, 18. Square B2, upper layer. 9, 12, 15, 17. Square B1, lower layer. 10, 13, 16. Baulk B1-B2.

The lure shank (Fig. 19) is also of moa bone. The proximal end has a groove on the sides and the ventral surface forming the line attachment, while the distal end has a similar groove, and a point mounting facet on the ventral

surface. There is a suggestion of lugs, as on bilateral shanks at Wairau (Duff 1956, p. 210), in the lateral bisection of the distal knob on the ventral surface by a notch. This shank is a fairly typical example of Crosby's Early Grooved Series of shanks. These are known widely in New Zealand although absent at Wairau. The form is most common in the Hauraki Gulf and Coromandel Peninsula (Crosby 1966, p. 101). Crosby regarded these shanks as an early adaptation to New Zealand conditions since several are known from other early sites. Two occurred at Pig Bay (N38/21) on Motutapu Island (Golson 1959, p. 46) and they also occurred in Ponui Midden (N43/1) (Nicholls 1964, p. 32). One was found in an early level of Kauri Point Pa (N53 - 4/5) (Green 1963, p. 70). This latter site association and their absence from early South Island sites, argues for regarding this type as intermediate, rather than simply early.



Figs. 19, 20. Lure fishhook and point, N30/5. 19. Surface. 20. Square B1, lower layer.

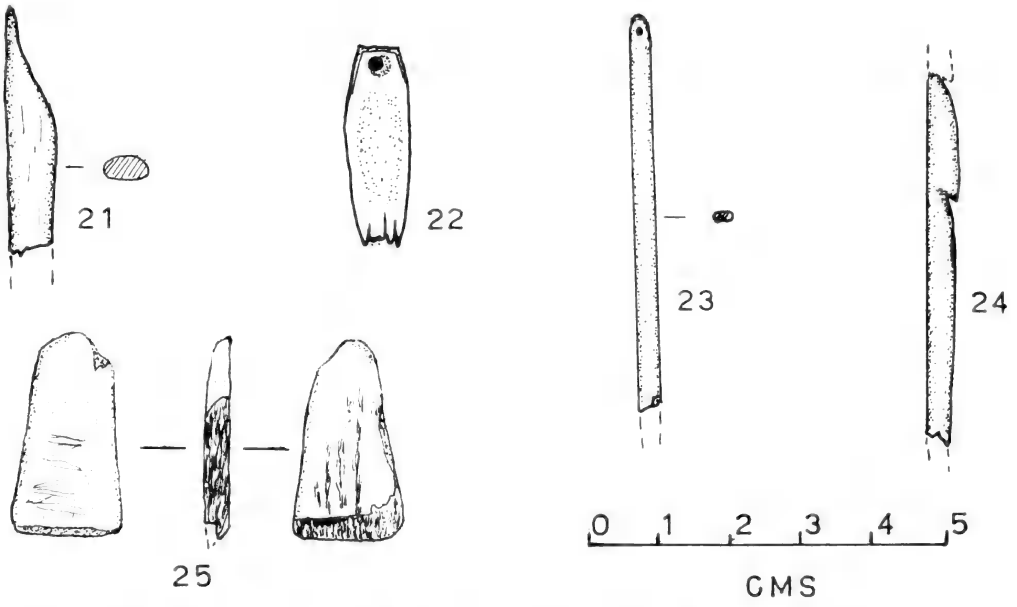
Although the shell lure point (Fig. 20) was not in association with the lure, the size of the mounting facet on the lure would not allow a point with a base length any larger than this. The use of shell for this point is unique, although the uniperforate form conforms to the usual pattern for the area (Crosby 1966, p. 148; Golson 1959, p. 45). Opito I variety hooks in shell are quite common and in view of the continued use of shell in the late lures, to claim a close relationship to tropical Polynesian lure points made of shell could be misleading. The increasing evidence that biperforate lure points, generally with a proximal extension, were the earliest type in tropical Eastern Polynesia (Suggs 1961, p. 83; Sinoto 1967, p. 358; Emory and Sinoto 1964, p. 149; Emory *et al.* 1959 p. 39) makes the almost complete lack of this form from the Coro-

mandel area of New Zealand surprising, particularly since it is well represented in the South Island. It does, however, occur at Houhora (Roe 1969, p. 43).

The method of manufacture of the fishing gear shows clearly on several specimens. Apart from the evidence of unused tabs, most of the hooks show that they were worked from flat tabs by drilling out a core, the holes being advanced from each side of the tab. The hook was then filed to shape. The outside of the point was apparently the last part to be rounded off. The lure point perforation was also drilled from either side.

Other bone material

An awl and a very fine broken needle (Figs. 21, 23) give evidence that some fine sewing work was performed on the site. A small worked piece of bone (Fig. 25) could be a bone chisel although it is somewhat similar to bone tools which were found at Houhora and interpreted as skin burnishers used in preparing skins for clothing (Roe 1969, p. 69). The short perforated tattooing chisel (Fig. 22) can be matched with similar examples from early sites (Duff 1956, p. 223 - 224; Roe 1969, p. 77) and differs substantially from the later form from the Hauraki Plains swamp *pa* (Shawcross & Terrell 1966, p. 425). It is made from a thin section of bird long bone.



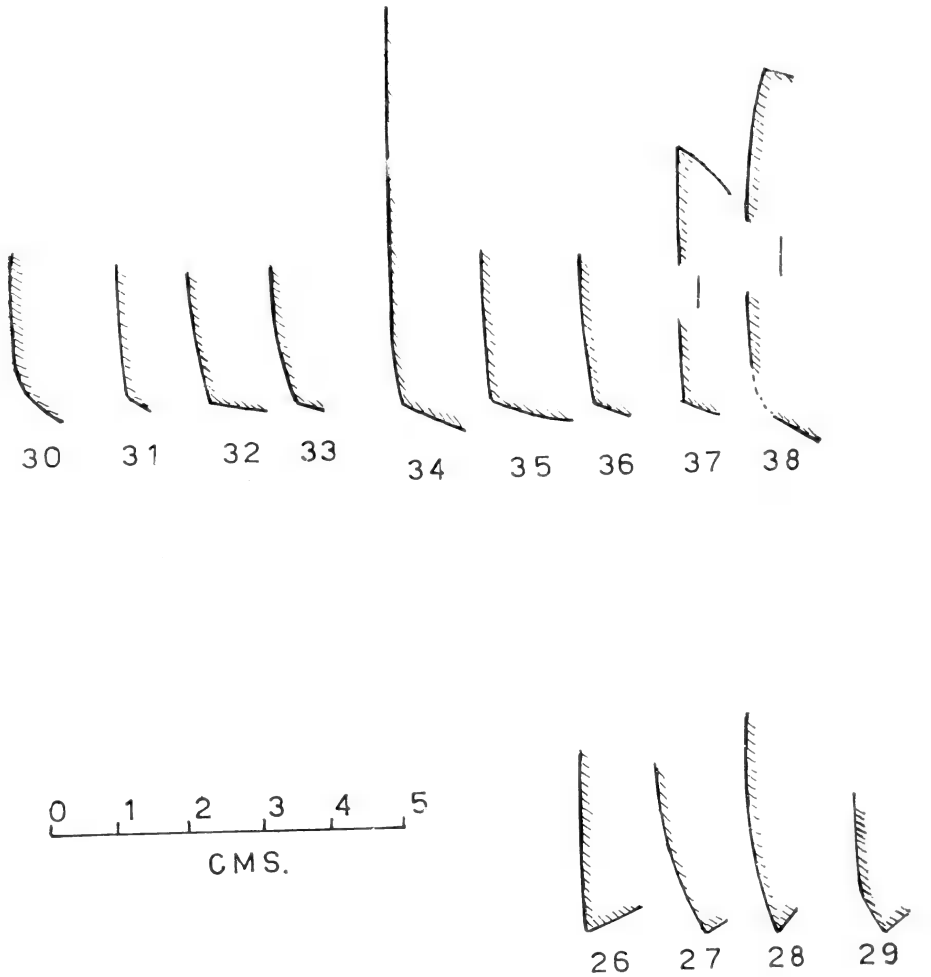
Figs. 21-25. Bone artifacts, N30/5. 21, 23, 24. Baulk B2-B3. 22. Surface. 23, 25. Square B2, upper layer.

The broken section of bird spear (Fig. 24) is a very important find. These spears are apparently a New Zealand innovation, none as yet having been found in tropical Polynesia and very few being known from early sites. This then provides important evidence that the Maori adaptation to New Zealand conditions was well under way when this site was occupied.

Besides the material mentioned above several amorphous worked pieces of bone occurred. These mostly showed signs of cutting or filing.

Adzes and adze flakes

Of 34 flakes from polished stone tools, 11 were polished on two surfaces suggesting they were from the edges of adzes. On four of these the surfaces meet at an acute angle (Figs. 26 - 28) but only one of these looks like a flake from the blade of an adze. All the other flakes appear to be from adzes which were being deliberately reworked. The remaining three flakes with acute angles are probably from triangular or trapezoidal sectioned adzes. The more obtuse angled of the flakes (e.g. Figs. 30, 31) may be from similarly sectioned adzes but the remainder are probably from rectangular sectioned adzes, some with convex sides.



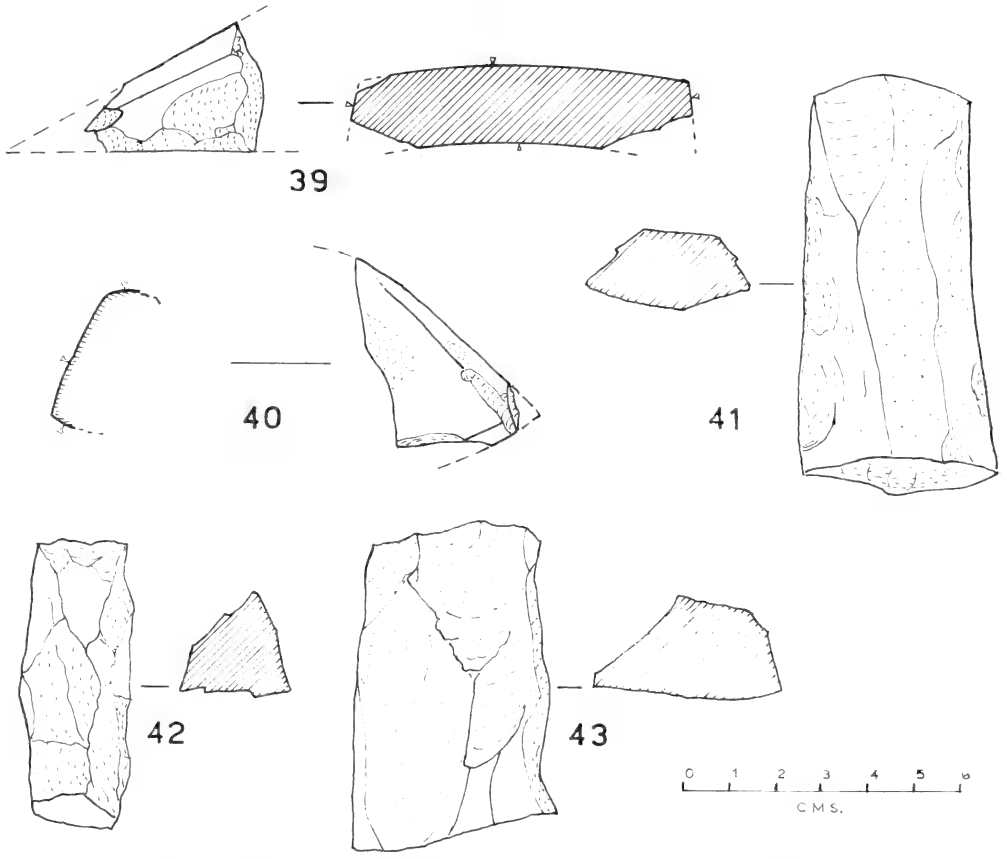
Figs. 26-38. Sections of flakes from polished tools. 26, 32 (part), 35. Square B3. 27. Square B1, upper layer. 28. Square B2, upper layer. 29, 38. Square B2, lower layer. 30, 31, 32 (part), 33. Baulk B2-B3. 34. Surface. 36, 37. Baulk B1-B2.

Two flakes showed three polished surfaces (Figs. 37, 38). The first of these came from the blade end of a rectangular sectioned adze as the edges defined by the surfaces met to form an acute angled corner of a right prism, such as is found at the blade. Two of the surfaces were perpendicular to the third. The extreme corner of the blade was missing.

On the second adze flake none of the three surfaces was perpendicular to another. Intersections of the three edges defined, when projected, were obtuse angled, and two acute angled. This flake was comparable with a section of one side of a deep triangular sectioned adze near the blade.

Although many of the flakes appeared to be from the same adzes only a few flakes could be fitted together. These, however, clearly showed successive flakes being removed from a platform at an edge of the adze. As well as polished flakes one flake from a hammer dressed surface was noticed.

Two substantial portions of finished adzes were found (Figs. 39, 40). Both had had flakes struck off them, one of which could be restored. One of the two is from the blade of a deep triangular sectioned adze, while the



Figs. 39-43. Broken adzes and roughouts N30/5. 39. Square B1, upper layer. 40, 42. Surface. 41. Square B1, lower layer. 43. Baulk B1-B2.

other is from the blade end of a rectangular sectioned adze with a hollow ground blade. In New Zealand the former are usually Duff (1956) type 4 A while the latter are usually Duff type 1 A. The Duff type 4 A is represented from surface collections elsewhere in Harataonga Bay. An unfinished Duff type 1 A from the bay is in a private collection. As it shows clear signs of reworking from a larger adze it is most likely to have come from this site.

A comparison of the materials of these flakes and adze pieces suggests that at least five different adzes were being reworked on this site. It is fairly certain that three different types of adzes occurred, deep triangular sectioned, rectangular sectioned, one at least with a hollow ground blade, and shallow triangular, or trapezoidal sectioned.

The rock types have not been closely studied but the most common is a basalt with dark phenocrysts. This material appears to differ from that from the quarry at Tryphena (Spring-Rice 1962, p. 94). The roughouts and flake material treated below are also of this material. Two other materials occurring in this assemblage of adze pieces are a dark grey-green metamorphosed mudstone and a light grey andesite (?).

The adze roughouts from the site are all small. Some have undoubted triangular sections while others have trapezoidal sections (Figs. 41 - 43). None had progressed to the hammer dressing or polishing stage before abandonment. All are apparently reworkings of large flakes. Almost all examples illustrate the deliberate striking of hinged flakes to reduce the angle of the striking platform nearer to a right angle. Possibly the trapezoidal sectioned adzes would become rectangular in section when they were finished.

Flakes

In comparison with the number of formal tools produced the quantity of flake material in the site is large. It consists of simple conchoidal flakes with no sign of retouch and little sign of use wear. Flakes of the basalt mentioned above are the most common. A few flakes of local water-worn greywacke boulders have been included in this assemblage of flakes. Flakes of a variety of siliceous materials are also common. Red jasper, brown chert, clear chalcedony and a range of less transluscent chalcendonies form the bulk of this material which was studied as a single collection of siliceous material. Obsidian was less common than siliceous materials and obsidian from the Mayor Island source was dominant. Only 5.9 % by weight and 10.5 % by number of flakes was non-Mayor Island obsidian.

Figure 44 shows the cumulative weight distribution curves of the four groups of flake materials. Clearly there is a wide range of flake size in all materials. Obsidian, possibly because of its brittle nature, has more small flakes, though many of the flakes weighing less than one gram are still usable as tools. The large proportion of the adze flakes in the smaller sizes may reflect close control of the re-working of adzes. In general, however, there is little to distinguish the four groups. On one site with many siliceous drill points the siliceous flakes are noticeably small (K. Fletcher pers. comm., site near Tauranga). No such case could be made here.

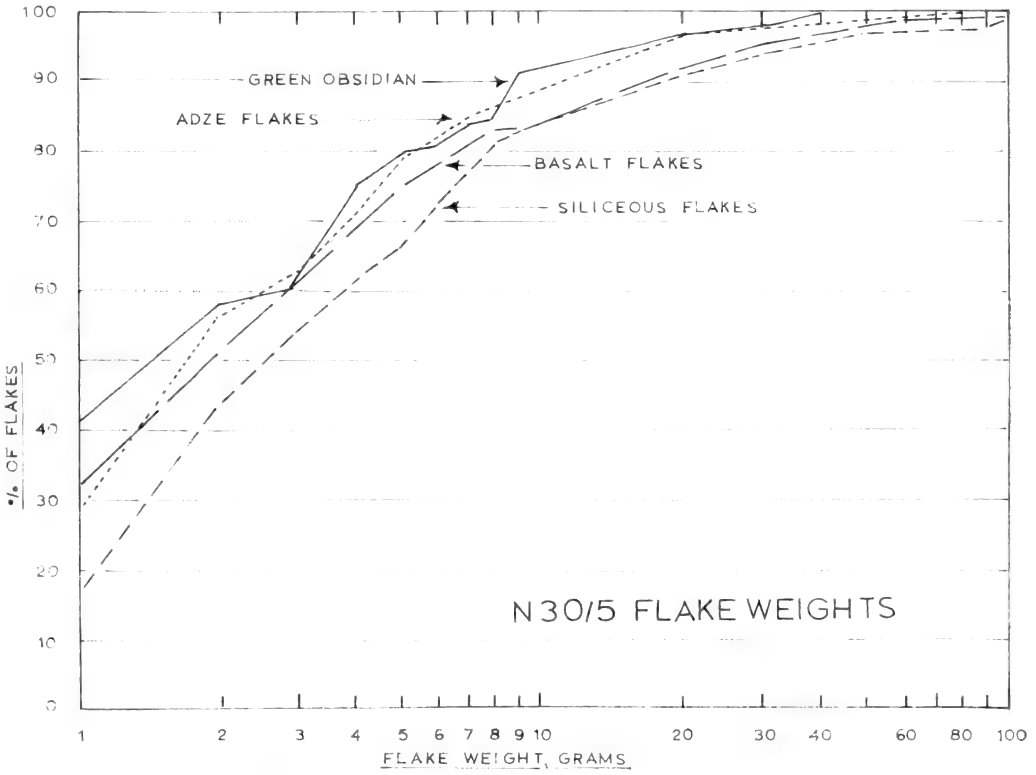


Fig. 44. Flake weight distribution curves for N30/5.

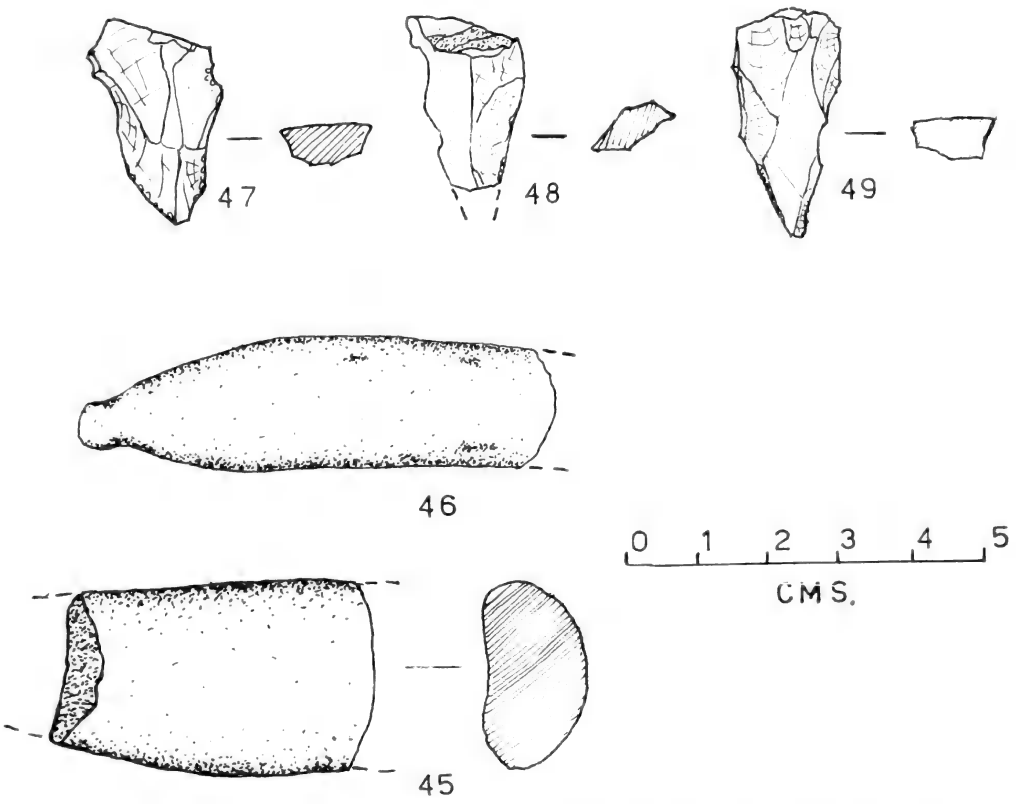
Green (1964) has put forward data showing early sites have higher proportions of Mayor Island obsidian than closer local obsidians, while later sites favour the closest source. The predominant use of Mayor Island obsidian here rather than the local material does suggest a relatively early stage in the exploitation of local materials.

Abraders

The edge of a flake of andesite shows wear consistent with its use as an attrition saw. Apart from this, only rhyolite has been used to make abraders. Most were apparently shaped first by flaking, as a number of otherwise unused pieces of this material were found. Another method of manufacture evinced from this bay has been described elsewhere (Law 1970). A few of the files had not been used after shaping while those which had were oval in section (Fig. 45). One showing unusual wear at one end (Fig. 46) had probably been used for shaping the inside curves of fishhooks.

Drill points

Six drill points were discovered, all worked from flakes of either brown chert or chalcedony (Figs. 47 - 49). Both the methods of manufacture described by Nicholls (1964, p. 30) were present, as well as two others. The two basic methods of working a flake to a point by flaking either edge from one face



Figs. 45-49. Files and drillpoints from N30/5. 45. Baulk B1-B2. 46, 47, 49. Baulk B2-B3. 48. Surface.

only or either edge from different faces, both occurred as at Ponui. A point worked on only one edge with a hinge forming the other was recognised while a fourth type with both edges flaked from both faces also occurred.

Miscellaneous

A core of andesite (?) showed signs of battering along its edges suggesting it had been used as a hammer stone. A small piece of the mineral asbeditis could only have been a curiosity to prehistoric men. Five shells of *Glycymeris laticostata* were encountered in the excavation. All were whole and four were pierced at the hinge (Fig. 50). This species lives only in deep water and could only be used for food after washing ashore in a storm, but no two of the five shells here form a pair. This shell is common on the beach today and it is noticeable that many are perforated at the hinge, apparently as a result of damage as they are washed ashore. The shells, then, were probably collected for some purpose. A collection was made of shells on the beach and from the whole of the midden area in the bay. This revealed that in contrast to the shells on the beach where only one third of the specimens were whole, the vast majority of the specimens from the middens were. Furthermore, of the whole shells, a far higher proportion of those on the midden were perforated at the hinge than

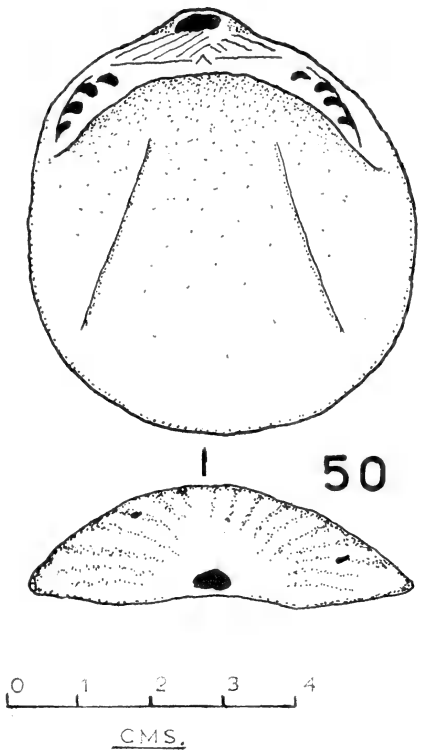


Fig. 50. Perforated *Glycymeris laticostata,* N30/5. Square B1, upper layer.

of those on the shore. This would suggest that the shells in the middens were selected for their completeness and their perforation. Possibly these were used as ready made necklace units.

Details of the artifactual material recovered are listed in Table 1.

Table 1. Artifactual material in N30/5.

	No.	Wgt. (g)
Worked Bone and Shell		
Broken fishhooks	13	
Broken unfinished fishhooks	5	
Lure shank	1	
Shell lure point	1	
Tabs	2	
Cores	4	
Needle	1	
Awl	1	
Tattooing chisel	1	
Broken bird spear	1	
Chisel (?)	1	
Worked fragments	5	
		48.9

Adze and Adze Flakes		
Polished flakes	34	179.3
Adze pieces	2	160.1
Roughouts	8	627.4
Flake Material		
Mayor Island obsidian	102	368.7
Other obsidian	12	23.0
Basalt flakes	228	1471.3
Siliceous flakes	223	1928.1
Abraders		
Files (some broken)	7	278.7
File blanks (some broken)	4	68.7
Cutter (attrition saw)	1	134.9
Flakes of rhyolite	36	259.4
Drill Points	6	24.8
Miscellaneous		
Hammer stone	1	284.2
Siliceous core	1	493.2
Perforated *Glycymeris laticostata*	4	51.5

FAUNAL REMAINS

While shell was not common in the site, fish, mammal and bird bone were. In the following sections shell identifications are by Miss J. M. Davidson, bird and mammal by Mr R. J. Scarlett and fish by Mr Brett Stephenson.

Shellfish

Although the midden was not concentrated a quantity of material sufficient for analysis was collected by sieving the material from all three squares. The species encountered are listed in Table 2.

Table 2. Shellfish in N30/5.

SPECIES	Wgt. (g)	% by weight
Lunella smaragda	263	21.4
Cookia sulcata	245	19.9
Nerita melanotragus	18	1.5
Haustrum haustorium	71	5.7
Neothais scalaris	84	6.8
Haliotis (?) *iris*	66	5.4
Mussel	73	5.9
Crassostrea glomerata	48	3.9
Amphidesma australe	30	2.5
Amphidesma subtriangulatum	5	0.4
Chione stutchburyi	48	3.8
Cellana radians	14	1.1
Cellana denticulata	64	5.1
Maoricrypta costata	4	0.3
Charonia capax	70	5.7
Mayena australasiae	66	5.4
Zediloma sp. *Melagraphia* sp.	5	0.4
Chiton	3	0.2
Modelia granosa	8	0.7
Austrofusus glans	2	0.2
Cantharidus opalus	2	0.2
Evechinus chloroticus	x	
Penion adustus	43	3.5
	1232	100.0
Not sorted	34	

The dominance of rocky shore species reflects the predominance of rocky shore environment near the site. All the usual food species from this environment are well represented but in addition there are a few shells of various species which have little economic use on account of their small size. Possibly they were collected merely as curiosities. Paua *(Haliotis)* and sea eggs *(Evechinus)* still attract the residents of the island to Harataonga Bay.

Of the species from other shores, only one, *Amphidesma subtriangulatum* is represented in a strand line collection from the shores of the bay. Pipi *(Amphidesma australe)* and cockle *(Chione stutchburyi)* are most unlikely to have grown in this bay, preferring much more sheltered conditions. They are almost certainly evidence of contact with an area where populations of these species occur. The closest such area today is six kilometres north-west along the coast. The moderate quantity of shell in relation to other faunal remains indicates shellfish did not play any large role in the inhabitants' diet.

Birds and mammals

In Table 3 an attempt has been made to give the minimum number of individuals which could be represented in the site on the basis of a count of repeated bones and immature bones. For the reasons given previously this has been done on a site rather than a stratigraphic basis.

Table 3. Mammals and birds in N30/5.

SPECIES	COMMON NAME	Minimum No.	Layer
Canis familiaris	Polynesian Dog	3 (1 immature)	b*
(?) *Arctocephalus forsteri*	Seal (?) Southern Fur	2 (1 male, 1 immature)	b
(?) *Euryapteryx geranoides*	Moa	1	u*
Diomedea sp.	Albatross, Royal or Wanderer	1	l*
Thalassarche (?) *cauta* subsp.	Mollymawk	1	u
Eudyptula minor subsp.	N.I. Little Blue Penguin	4	b
Pterodroma macroptera gouldi	Grey-faced petrel	5	b
Puffinus gavia gavia	Fluttering Shearwater	2	b
(?) *Pachyptila turtur*	Prion (small) (?) Fairy	1	[1]—
Larus sp.	Gull red or black-billed	1	—
Phalacrocorax (?) (Stictocarbo punctatus punctatus)	Shag (?) spotted	2	u
Phalacrocorax carbo novaehollandiae	Black shag	1 (nearly complete)	—
Phalacrocorax (?) *melanoleucos brevirostris*	Shag (?) white-throated	1	u
Phalacrocorax sp.	Shag, smaller than spotted, larger than black	1	—
Anas (?) *castanea chlorotis*	Teal (?) brown	1	l
Nestor meridionalis septentrionalis	N.I. Kaka	3	b
Prosthemadera novaeseelandiae novaeseelandiae	Tui	1	u
Hemiphaga novaeseelandiae novaeseelandiae	N.Z. Pigeon	1	l

* Squares B1, B2. u — upper layer, l — lower layer, b — both. [1]—, Square 3 and baulks.

The low number of immature bird bones in the material from the whole bay was deemed worthy of note (R. J. Scarlett pers. comm. to R. C. Green) and this site is no exception. The moa consisted entirely of industrial fragments but green breaks were definitely present.

A good deal of information is available on the bird population of Great Barrier and neighbouring Arid Island (Bell & Brathwaite 1964). Other islands off the north-east coast of the North Island also have rich avifauna when compared with the mainland. Three areas are bird sanctuaries, Little Barrier, the Poor Knights and the Hen and Chickens, while another group, the Mercury Islands, has a large bird population because of some intact vegetation. Again considerable information is available (Skegg 1962, p. 153; 1964, p. 159; Turbott 1961, p. 140).

Moa is of course extinct, but virtually all the other birds listed in Table 3 still occur in this locality. Mollymawk and albatross are known only at sea. Of all the other birds only spotted and white-throated shags and fairy prion do not now nest on Great Barrier although they nest on other off-shore islands. Brown teal was near extinction on the island at European contact but Great Barrier is now its only stronghold. Maori depredations may well have been responsible for the previous reduction.

Burrow-nesting birds are well represented in the site and the method of taking these in the burrow is well known. The taking of albatross is more difficult, but it may be possible from canoes when the birds are gorged, or in still conditions when they cannot get airborne. Little is known of shag taking, but in Patagonia they were taken in their rookeries at night either by stealth or by disorienting them with flares and collecting them as they tried to fly away (Bridges 1948, p. 98). Kaka, tui, and pigeon were undoubtedly speared very easily. The presence of these birds as well as the bird spear is instructive. Water troughs to take pigeons and decoy birds to take kaka were fairly important parts of Maori fowling equipment for at least part of the year. With spears as an early cultural item the additional presence of these two items would not be too surprising.

The presence of seal and dog as major items of diet is an important trait. Seal and dog appear to be more common in early middens than late (Green 1963, pp. 52, 56). Seals are now rare visitors to this coast. While European depredation of seal populations must influence the modern situation it can be inferred that their numbers were greater in relation to human population early in the local prehistory. The economic position of dogs in New Zealand prehistory has been fully discussed by Allo (1970, 1971).

The needle and awl could well have been for sewing dog, seal and moa skins.

Fish

The fish remains proved to be very fragmentary. Despite this, careful study enabled 43 % of the fragments to be identified. The species are given in Table 4.

Table 4. Fish in N30/5.

SPECIES	COMMON NAME	No. identified pieces	Layer
Chrysophrys auratus	Snapper	321	b*
Polyprion oxygeneios	Hapuka	5	b
Navodon scaber	Leather jacket	10	b
Coridodax pullus	Butterfish	5	l*
Allomycterus juculiferus	Porcupine fish	1	[1]—
Verreo oxycephalus (probable)	Parrot fish	1	u*

* Squares B1, B2. u — upper layer, l — lower layer, b — both. [1]—, Square B3 and baulks

Because the material was so fragmentary no individual counts were possible. Leather jacket was identified almost exclusively by its distinctive spine giving eight as its minimum number. The dominance in the table of snapper can only represent a dominance of snapper in the fish caught. Some of the snapper is very large. The presence of snapper and hapuka is consistent with line fishing with baited hooks, and this style of fishing is well indicated by the artifacts. Interestingly, at an earlier excavation on the Coromandel Peninsula, a broken point of an Opito I fishhook was found between the jaws of a snapper. In the dominance of snapper this site compares closely with the lower layer at Tairua (N44/2) (Smart & Green 1962, p. 262); and with Hot Water Beach (N44/69) and Houhora. If any economic activity characterises the early settlement in the north of the North Island it is intensive line fishing for snapper. Certainly moa hunting must come a long way behind.

Leather jackets and butterfish are both found in rocky shallow water and both have small mouths, probably too small to take any bone hooks. Witter (1969, p. 51) showed that leather jackets are common in middens in this area. He considered they were caught by trapping. Netting with hand held baited nets is a possibility he did not consider. This method has been recorded for New Zealand (Banks 1963, p. 456). Whatever method was used it is certain that some other method of fishing beyond line fishing and trolling was known. Witter to the contrary, leather jackets are good eating. Porcupine fish flesh however is poisonous and this fish could only have been brought in with the catch as a curiosity.

Despite the presence of a lure no species of fish normally taken while trolling appears in the site. Unfortunately there are no data available from other sites to confirm if this is typical, but if it is, the variety of lures found in this area is all the more remarkable.

General

The wide variety of the faunal remains is worthy of note. There are 21 species of shellfish, 18 identified species of birds and mammals, one further unidentified bird and six species of fish. The varied environments from which these came and the differences of these environments from those in any tropical homeland argue that the former inhabitants of this site had dwelt in this part of New Zealand long enough to know it well.

While the range of environmental sources represented by the faunal remains at a site are capable of being identified, the exploitation of these environments as a set of economic activities is more difficult to reconstruct. For instance, there are several ways bone material can arrive in a site. Waste products from fish, lizards, rats, dogs, birds and sea mammals procured for food are the obvious source for the majority of the items, especially if it is assumed that the materials on a site reflect to any degree the economic activities of the group. However, procurement for food does not necessarily always imply consumption, as parts of some items could be preserved or simply wasted. Conversely, consumption of a preserved bird or fish at a site need not imply that it was present in the immediate locality during the season of occupation. Apart from food, live or recently deceased birds may be procured solely for their feathers or useful bone. Similarly, useful bone could be collected without consumption of the flesh from recently deceased mammals such as dogs and seals, or from semi-fossil deposits of bone or even from older middens. As well, the risk is always present of dogs, rats and possibly some birds expiring on the site without being eaten. Thus it would almost certainly be wrong, for example, to assume that moa, or the almost complete shag, or the *Glycymeris laticostata* shellfish were consumed on this site.

Finally there is the difficult question of dogs. Dogs may well have had to forage for themselves, consuming what was left on the midden heaps and supplementing it with their own hunting. Indeed unless there is evidence to the contrary, this is to be expected. Thus when dogs were present in any numbers they would almost certainly be responsible for the removal of bone including fish from a midden, and possibly also for the introduction to the site of bird bone, or the bones from decomposing remnants of sea mammals. Rats might also be involved in the removal of bone. In view of the presence of dogs, and bones gnawed by rats on this site, it can be assumed that these animals in fact have disturbed it, although no rat bones were found.

There is also the possibility that some bone material has been removed by human activity, either in the process of manufacture of tools, or by preservation of some items for consumption elsewhere. The first activity would certainly seem to be a factor at this site, while there is the possibility that preservation was also carried out, particularly of petrels and fish.

Clearly then, a diet as attested by the bone composition of a midden may differ considerably from the actual diet of the site's occupants as a result of the above factors. Any conclusions on environmental determination or cultural preference should be tempered by this possibility. Additional biases are possible from excavating small parts of sites or sites which have accumulated in a very short time. Continuing in this vein it is possible by inventing new degrees of freedom to demolish economic archaeology almost completely. Suffice it to say that any reconstruction can only be as complex as the evidence will allow, and not as complex as is theoretically possible.

DATING

As part of his investigation of obsidian in New Zealand, Green measured a hydration rim on one flake from this site. A freshly exposed surface of this natural glass develops a thin surface layer of hydrated material called a rim. This rim thickens at a rate dependent on temperature. Comparison of rim thicknesses on obsidian from a number of sites enables a relative chronology to be established.

The flake measured was of Mayor Island obsidian from the lower layer of square B2 (A.U. register No. 777/2). Five measurements were made at different points and gave readings of 1.3750, 1.6500, 1.7200, 1.5125 and 1.6500 microns respectively. Comparison with other sites (Green 1964, p. 135) indicated that this flake is younger than the pre-Rangitoto ash occupation at the Sunde site (N 38/24), contemporary with layer 2 at Tairua (N 44/2) and older than any material at Opito Beach midden (N 40/3). The first site is earlier than the Rangitoto ash which is now best carbon dated as 14th century (Golson & Brothers 1959, p. 569; J. M. Davidson pers. comm.), but as the occupation may be considerably earlier than the ash this date does not limit the occupation at Harataonga Bay. Tairua has two radiocarbon dates from the same oven of A.D. 1072 ± 49 and A.D. 1507 ± 40, the latter of which Green rejected as probably contaminated in the interval between collection of the two samples. Although this is justified on cultural grounds (Green 1967, p. 83, Smart & Green 1962, p. 249), it is a massive contamination. The Opito site has a date of A.D. 1310 ± 50 and this seems correct in relation to other sites in the area of Opito.

As mentioned above a considerable amount of pumice was found in the site, the stratified material being predominantly in the lower layer. This pumice was fine in texture, hard, dark in colour with occasional banding and inclusions of dark minerals, conforming in every way to Wellman's (1962 p. 78-80) description of Loisels. This was confirmed by sending a sample to Professor Wellman (pers. comm.). Consideration of radiocarbon dates places this pumice at about the 13th century. Its position in the site suggests that occupation took place on a lag layer of this pumice and thus is in or post-dates the 13th century.

However the Opito site (N40/3) has Loisels pumice stratigraphically above the layer carbon dated. By pumice stratigraphy N 30/5 should be younger than Opito but by obsidian fringes it should be older. Either of these inferences could be at fault, for in the first case the Opito pumice need not be a primary deposit, and in the second the work on obsidian fringes is only in a preliminary stage.

Thirteenth and 14th century carbon dates need very little correction and retain unimodal frequency distribution when reflected through the Bristlecone pine correction curve. However the early Tairua date becomes bimodal with peaks about 1060 and 1210 AD. Clearly N 30/5 will not be closely dated until more progress is made on the chronological problems of northern New Zealand. A 13th century date does seem the most likely.

BURIAL

In test pit 8 a burial which was on the point of eroding out of the dune was excavated. This proved to be a burial of a child in a crouch position facing out to sea. The arms were folded across the chest and the knees drawn up to the chin. The lower legs were crossed and in the limited excavation there were no grave goods. There was no observable burial pit in the clean dune sand. The immature state of the bones made a sex determination difficult. Only one of the usual characteristics gave a positive answer and reliance on only one is dangerous. This was the sciatic notch which was acute, suggesting a male.

The full deciduous dentition had erupted and the second molars of the permanent teeth were formed but had not erupted. This would suggest an age between

four and six years. However the skull and teeth had some unusual features. The bite was edge to edge and all the teeth were faceted by heavy grinding wear. This is remarkable in milk dentition. As well as this the sagittal suture of the skull had largely closed and there was a remarkable constriction behind the frontal bone. These features suggest the individual had some congenital abnormality and this in turn could explain the heavy grinding wear, as deciduous dentition is often retained for longer in such individuals.

The lower jaw was broken on the right side and a tooth was missing from the upper jaw in a parallel position which suggests violent death. On the eroding surface of the dune spilling down the slope from above the burial there was a small assemblage of obsidian flakes and one core, on to which some of the flakes could be fitted. Mayor Island obsidian was in a minority. This could be an assemblage of scarification tools but it is impossible to place the flakes as contemporary with, earlier or later than the burial on purely stratigraphic grounds. This burial can almost certainly be related to burials found previously at this end of the beach, some of which had greenstone ornaments associated (H. G. Overton pers. comm. to W. Spring-Rice).

The proximity of this burial to N 30/5 is interesting but not conclusive. Crouch burials are certainly an early form (Emory and Sinoto 1964, p. 148) and the trussed burials at Wairau Bar are not dissimilar (Duff 1956, p. 47-48). Proximity of burials to living sites is not unexpected in early phases of New Zealand prehistory but the presence of greenstone in some burials and the continued use of crouch burials in late times make a late date in this case rather more attractive.

SEASONALITY

A good many of the animals present in this site have some seasonal restriction to their taking or other characteristics which can be used to demonstrate when the site was occupied. All of this seasonally restricted material seems to occur in both layers of the site.

The fur seal is in recent times an infrequent visitor to this coast. A well attested pattern of behaviour of this seal is for some of the males accompanied by a few cubs to move north for the winter returning to the southern breeding grounds after October. A few do however stay on through the summer, at least at Kaikoura (Stonehouse 1969, p. 520). It would appear that in early prehistoric times this pattern extended to the north of the North Island. The presence in this site of male and immature specimens is strong evidence in support of this pattern. It would appear likely on this evidence that the site was occupied for at least part of the winter until October or thereabouts.

Burrow-nesting birds are generally species which spend little time ashore, other than to nest, thus they are almost certainly taken from their burrows in the nesting season. Seasonal data on these birds, from a wide variety of sources, is summarised in Table 5.

Table 5. Seasonal occupation of nesting burrows.

COMMON NAME	USE OF BURROW	
	ADULTS	NESTLING
N.I. Little Blue Penguin	Aug. - Dec.	Oct. - Dec.
Diving Petrel*	April - Dec.	Sept. - Dec.
Fluttering Shearwater	Sept. - Mar.	Nov. - Mar.
Fairy Prion	Oct. - Feb.	Dec. - Feb.
Grey-faced Petrel	All year	Aug. - Jan.

* Bird found in eastern midden

The penguins spend most of the remainder of the year at sea but they do come ashore in storms. All the petrels except grey-faced tend to become less common out of the breeding season, and the majority move well off shore.

In the northern North Island the grey-faced petrel replaces the sooty shearwater as the traditional mutton bird. They are still taken on Red Mercury Island, Mokohinau Island and White Island in large numbers. The immature birds are taken in the month of November. In recent times, despite the large numbers taken (3000 on White Island), no preservation is carried out as in the south (Gillham 1965, p. 225). The author is aware of no records of such preservation ever being carried out in the north.

Other birds are not definitely seasonal. Despite the well known seasonal methods of taking pigeon, kaka and tui, their taking in other seasons is far from impossible, and continuous exploitation, particularly of kaka, must have been possible.

The evidence of the birds is not very definitive. A short occupancy during or within the months of October to December would be sufficient to explain the evidence. This does not rule out continuous occupation, of course, and an occupation which ended in August/September and began again in January or February could still accommodate the evidence of the birds. It is surprising that of the minimum number of 12 petrels and penguins represented none are immature. This would suggest that the occupation or at least the birding took place early rather than late in summer, but as this is negative evidence, it should be used with caution.

In the south of the South Island of New Zealand several species of shellfish have been observed to lay down annual growth rings and possible daily growth rings have been observed in *Chione* (Coutts 1970). These give promise of very close seasonal control of sites. The shellfish from Harataonga Bay do not show any clear annual growth ring so this technique could not be applied here.

Of the fish represented only two are in any way seasonal. Snapper are more common in late summer and autumn (Shawcross 1967, p. 116-118) but it is not impossible to take them over the whole year. Hapuka move to deep water in the winter and can only be caught on very long lines. Spring to autumn is therefore more likely.

A difficulty of any investigation of seasonality is that no one site can clearly demonstrate when it was not occupied. At a site where fish drying or bird preservation evidence might be found in the form of incomplete skeletons, it is a reasonable assumption that a parallel site must have existed. However where this evidence is lacking there are always the possibilities that the site was occupied but the inhabitants were at times eating food which left no remains or subsisting largely on that which was available in all seasons. Only the finding of a parallel site which provides evidence for the remainder of the year can remove this doubt.

At this site we have evidence of occupation in the spring at least. The bird bone showed no clear evidence of bird preservation, and the fish bone was too fragmentary to demonstrate fish drying. It must then remain a possibility that the site was continuously occupied for a period measuring up to several years, though in this case the number of people involved must have been small.

If the site was continuously occupied the obsidian and sheltered shore shellfish must have been acquired by periodic external visits either to or from the bay, rather than a single initial supply being brought in, which would be more likely in the case of a group occupying the site only temporarily. The two layers in the site could well have been formed during a short visit. There is no evidence for a decline in the available raw materials in the upper layer, which would rule out any single seasonal occupation which only used raw materials brought at the beginning.

Two successive seasonal occupation forming the separate layers could explain this difficulty.

DISCUSSION

The earliest period of North Island prehistory might be more fairly described as arcane than archaic. Of the major artifact-producing sites of Opito (N40/3), Sarah's Gully (N40/9), Pig Bay (N38/21) and Houhora, only the latter has a report available (Roe 1969). This, an unpublished thesis, describes the artifacts but not the economy or the structure in the site. Virtually all the other early sites for which reports exist, such as Tairua (N44/2) and Ponui (N43/1), contained so little in the way of artifactual material that it is only possible to refer them to Golson's Archaic phase or Duff's Moa-Hunter Period and make no further elaborations to the sequence by setting up each site as an individual component.

To the extent that it is not published and therefore not completed the first problem Golson set out to solve remains unsolved. This was discovery and definition of the earliest period of prehistoric occupation in the North Island. To only a small extent can this site correct this situation.

Green initially placed N30/5 in either his Settlement Phase or early Developmental Phase (Green 1963, p. 46) but with this analysis completed there are good grounds for removing it from the Settlement Phase. In the first place the initial settlement of this part of New Zealand was probably some time earlier than the dating of this site. Cultural material certainly underlies Loisels pumice elsewhere in the North Island (Wellman 1962, p. 88). This would bear out Groube's contention (1968, p. 145) that the earliest sites in this area of New Zealand are still unexcavated.

There are several other grounds. The range of species exploited and the variety of raw materials used suggests that the inhabitants of this site knew well the area in which they were living and had adapted their gathering techniques to this environment. The tool kit, while still of early types, shows at least one item, the bird spear, hinting towards later adaptations of Maori culture. The lure shank might be similarly interpreted.

The presence of no more than one species of moa and the lack of a single other extinct bird, such as are not uncommon in basal layers of other Archaic middens, are negative evidence suggesting the site is not very early in the sequence. Green's sequence of phases is now rather dated although it is still a useful frame-work. In the lack of better, this site could be placed in a Developmental Phase.

The range of material from N30/5 can only lead to the conclusion that it was a generalised occupation site, where many different activities were carried out. While no evidence of structures was encountered in the excavation the slabs of rock found in test pit 7 might suggest that some structures existed elsewhere on the site.

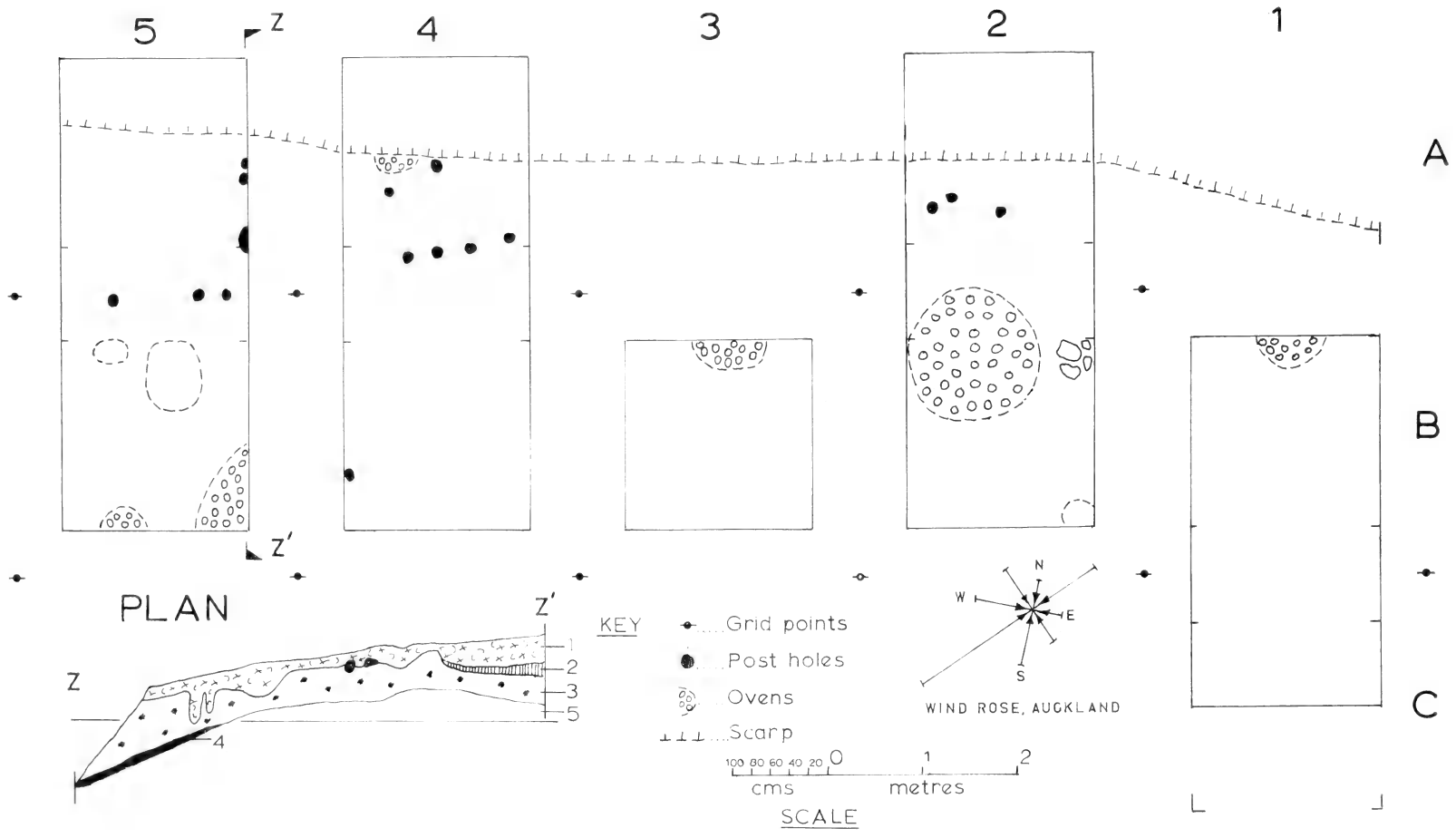
Following Green's criteria, if the site belongs to the Developmental Phase, its inhabitants should have lived in semi permanent settlements but with some site specialisation beginning to appear (Green 1963, p. 101). Green's conclusions on the nature of settlement were widely criticised and as yet little unequivocal evidence has been published to demonstrate the permanence or otherwise of the early settlement.

It is questionable whether it is more dangerous to assume that movement was common or uncommon. To prove movement from archaeological evidence, permanent settlement should be assumed and the evidence made to prove otherwise. However, ethnographic analogy suggests that groups practising exploitational economics regularly move, so to insist on lack of movement until proved otherwise may be dogmatic. If the site is seen as a near contemporary of Sarah's Gully settlement (N40/9), Skipper's Ridge (N40/7) or the Moturua Garden, Green's conclusion on site specialisation is tenable as a tendency towards specialised storage components must be occurring. But site specialisation need not imply seasonal or irregular movements over more than a few hundred yards or on a daily basis. The early settlement pattern for northern New Zealand must remain an open question.

The Eastern Midden N30/4

At the eastern end of the bay lies the second site excavated (Fig. 1). It is situated on a low natural terrace immediately behind the beach (Fig. 51). Before excavation commenced the terrace was not grassed and the midden material showed on the surface.

Eight and a half 2 m squares were excavated and several of the 1 m baulks between the squares. The original purpose in excavating this site was to test sampling and analysis techniques for diffuse middens that Miss J. M. Davidson was studying as part of her M.A. research at Auckland University. As she outlined in her thesis (Davidson 1964, p. 130), this was not entirely successful owing to a misunderstanding on the part of some of the excavators, but six squares were



HARATAONGA BAY, N30/4, PLAN AND SECTIONS

Fig. 51. Site plan N30/4, the eastern midden.

sampled by retaining all shell and bone material which did not pass a $\frac{1}{4}$ inch sieve (6.3 mm). It was originally intended to quantify the oven stone and charcoal in the site, and to take comparative samples with $\frac{1}{8}$ inch sieves but this aim was not realised. Over 40% of the extent of the midden was sampled. Given the complete state of most of the shell, a $\frac{1}{4}$ inch sieve can be expected to yield reliable samples.

STRATIGRAPHY

The stratigraphy proved to be simple. The surface midden layer, layer 1 was fairly homogeneous, consisting of dark grey sand, with inclusions of rock, charcoal, shell and bone. This layer was up to 40 cms deep and in most places overlay sterile white beach sand, layer 5. At the base of layer 1, a series of depressions were found, most containing ovens with oven stones still in place. As shown on the section (Fig. 51), one of the oven depressions was partly filled with sand mixed with charcoal and occasional pockets of burnt sand. This was called layer 2. In a restricted area along the seaward side of row 5 an earlier cultural deposit occurred, separated from layer 1 by layer 3, a layer of clean white sand with occasional charcoal inclusions. The lower cultural deposit, designated layer 4, consisted of a thin sloping lens of black sandy material with frequent fishbone. Underlying the whole site was sterile beach sand, layer 5.

In square A-5 the midden from the lens was not collected as a separate sample. However, because all A row samples of layer 1 came from partial squares none was used in the midden analysis. If the sloping lens originally extended to the landward, its constituents could not have included any heavy material, for these would appear as a lag layer between layers 3 and 5. The charcoal in layer 3 may therefore have derived from wind erosion of lenses similar to layer 4, and in places layer 1 may have been built up on a lag layer from this earlier activity. Because all the materials used in the analysis belong to the final occupation, the site will be treated as if it were a single layer.

Fifteen post holes were discovered at the base of layer 1, ranging from 4 to 35 cms deep. As shown on the plan most of these formed a line parallel to the beach beyond the ovens.

ARTIFACTS

Artifacts were rare on this site, only a very small quantity of flake material being found (Table 6). In size the obsidian flakes averaged less than one third the size of the flakes in the western midden (measured by weight), the higher proportion of non-Mayor Island obsidian than in the western midden is highly significant (binomial theorem) and the lower proportion of siliceous flakes is similarly highly significant (Chi squared). One worked section of seal bone was found as well as one unworked dog tooth, possibly being held as raw material for a fishhook point. Two examples of *Glycymeris laticostata*, the shell possibly selected for pendants in N30/5, were found. They were not a pair. One with many worm holes showed no perforation, but the second, which had been broken, had a perforation like those on some shells from N30/5. Two sections of *Dentalium nanum* were found which are undoubtedly units from some ornament. In the paucity of the artifacts, this site contrasts vividly with the western midden, N30/5.

Table 6. Artifactual material in N30/4.

	No.	Wgt. (g)
Mayor Island obsidian	6	10.7
Other obsidian	7	4.4
Siliceous flakes	2	69.4
Worked bone	1	—
Dentalium shell sections	2	—

FAUNAL REMAINS

Shellfish

The species encountered are given in Table 7.

Table 7. Shellfish in N30/4, by squares.

SPECIES	SQUARE B1 Wgt. (g)	B2 Wgt. (g)	B3 Wgt. (g)	B4 Wgt. (g)	B5 Wgt. (g)	C1 & Baulk Wgt. (g)	Total %
Lunella smaragda	1257	447	984	2069	1058	1183	56.6
Nerita melanotragus	122	271	191	459	1160	47	18.2
Chione stutchburyi	—	17	35	210	—	4	2.2
Amphidesma australe	94	70	72	96	38	19	3.1
Amphidesma subtriangulatum	64	71	151	105	40	80	4.1
Amphidesma sp.	71	12	23	35	17	5	1.3
Cellana sp.	7	5	11	47	38	3	0.9
Cookia sulcata	353	39	32	47	31	44	4.2
Neothais scalaris and *Haustrum haustorium*	219	48	129	152	114	80	6.0
Haliotis iris	69	29	35	49	32	30	1.8
Zediloma sp. *Melagraphia* sp.	32	—	12	13	36	5	0.8
chiton	—	3	1	1	3	—	0.1
Zethalia zelandica	—	—	3	2	—	—	x
Maoricrypta sp.	—	—	—	1	—	—	x
Pallium convexum	—	2	—	x	1	—	x
Penion adustus	—	—	—	8	—	—	0.1
Cantharidus opalus	—	—	1	—	—	—	x
Prototheca crassicosta	—	9	—	—	7	—	0.1
Mayena australasiae	—	33	—	—	—	—	0.3
Anomia walteri	—	—	—	—	1	—	x
mussel	5	3	—	—	—	—	0.1
Charonia capax	7	x	x	—	—	—	0.1
Cominella glandiformis	x	—	x	—	—	—	x
Total	2300	1059	1680	3264	2576	1500	100.0
Unsorted	48	242	539	212	8	126	

Comparison of the shell content of this midden with that of the western midden (see Table 2 and Fig. 58), shows they have a remarkable similarity, with the same species dominating both middens but with some changes in frequency. Shellfish from environments other than rocky shores show some increase and indicate that some contact with areas some distance away was maintained. The main difference between the sites is the far greater importance of shellfish generally in the diet at this site.

The ratios of *Lunella* to *Nerita* in the two sites alters from 14.5:1, to 3.1:1. If the ratios of the various shells in each site are studied it can be seen that the preference for the larger *Lunella* over *Nerita* is typical of a general preference for larger shells. The large species *Cookia sulcata* and *Haliotis* were both more popular in the western midden. While this might be seen as a cultural preference the increase in imported shellfish in the later site tends not to support this. A more likely explanation is that the occupants of the later site could not choose to be selective in collecting shellfish as the inhabitants of the western midden could.

This needs qualifying as it does not prove that the shellfish in the bay were in any way depleted or reduced in size before the collection started if there were two separate incursions into the bay. Nor should it be taken to prove that the population was at a level where they could not afford to be selective in their choice of shellfish for a long period. To prove any of this would take far more evidence. All that is indicated is a heavier demand for a short period at least, for which there could be a variety of causes.

The variability from square to square in N30/4 is noticeable, both in the amount of shell and in the proportions of different species. The proportion of *Lunella* to *Nerita* is particularly variable, possibly indicating that these two species were collected, or at least eaten and dumped, at different times. As *Nerita* tends to live on the littoral fringe higher than *Lunella* (Morton & Miller 1968, p. 80-81) this variability could arise from collecting at different stages of the tide.

The near disappearance of mussel and the disappearance of rock oysters *(Crassostrea)* is linked with a decline of their predators *Haustrum* and *Neothais* respectively, though both of the latter also prey on other shellfish, particularly *Lunella* and *Melagraphia*. Intensive rock shellfishing as carried out by prehistoric Maoris must have severely disturbed ecological balances such as these.

Birds and mammals

The material recovered is listed in Table 8.

Table 8. Mammals and birds in N30/4.

SPECIES	COMMON NAME	Minimum No.
(?)	Whale	1
Canis familiaris	Polynesian dog	2 (1 immature)
Rattus exulans	Polynesian rat	1
(?) *Arctocephalus forsteri*	Seal (?) Southern Fur	1
(?)	Moa	1
Diomedea sp.	Albatross, Royal or Wanderer	1
Eudyptula minor subsp.	N.I. Little Blue Penguin	1
(?)	Large petrel, immature	1
Pterodroma macroptera gouldi	Grey-faced Petrel	1
Puffinus gavia gavia	Fluttering Shearwater	3 (1 immature)
Puffinus sp.	Petrel, smaller than *P. gavia*	1
Pelecanoides urinatrix	Diving Petrel	1
Phalacrocorax p. punctatus	Spotted Shag	1
Nestor meridionalis septentrionalis	N.I. Kaka	1

The fragments of whale, moa, seal and albatross are almost certainly only industrial waste and need not imply consumption on the site as all were rare and several fragments were worked. The large petrel is possibly black petrel which still nests on Little Barrier. Despite the vastly greater quantity of shell at this site the number of birds has decreased. Against 14 species which were probably consumed at the previous site only 8 were found here and the minimum number of individuals also decreased. Dog however, seemed to retain some importance if seal declined. The decline in the number of shags and land birds is the most remarkable feature. As well as dog bone, faeces thought to be from dogs were recognised. These contained fish bone and scales.

Fish

As in the western midden the bone was very fragmentary and only an identified fragment count is possible. The species encountered are listed on Table 9.

Table 9. Fish in N30/4.

SPECIES	COMMON NAME	No. identified pieces
Chrysophrys auratus	Snapper	83
Navodon scaber	Leather Jacket	92
Coridodax pullus	Butter Fish	9 (all doubtful)
Squalus blainvillii	Dog Fish	26
Thyrsites atun	Barracoutta	2
fam. *Labridae*	(?) Red Pig Fish	4 (all doubtful)
Arripis trutta	Kahawai	8
Trachurus declivis	Horse Mackerel	2
fam. *Carangidae*	—	5 (all doubtful)

As at the previous site, leather jacket was recognised by its single dorsal spine giving 61 as its minimum number of individuals. All the dog fish bone was vertebrae and possibly represents only one individual.

Both the increase in the number of species represented and the decline of the dominance of snapper replaced by leather jacket are noticeable when comparing this site with the western midden. Again the presence of leather jacket and butterfish would argue for some form of trapping or netting but in the absence of any fishing artifacts from the site the method of taking the remainder must remain unknown. The presence of kahawai and barracoutta might be taken as an indication of more successful trolling than was evinced in the western midden.

The proportional decline of snapper could be a seasonal effect, or could be a result of a wider fishing technology employed at the time of this site. No sound case could be made for a decline of the snapper population. Snapper is still dominant on some apparently late sites (Shawcross 1967).

SEASONALITY

Some of the animals appearing in this site are seasonally restricted as at the western midden. Since the seal bone in the site is almost certainly industrial waste no claims can be made from the presence of this animal.

The burrow-nesting birds are again useful. An occupation in the months of November or December is sufficient to explain the evidence, though an occupation which ended in August or October and began again in January, February or March would also be sufficient. This does not rule out continuous occupation however. The higher frequency of immature birds than at the other site might suggest a relatively late period of birding.

The comments on the late summer and autumn increase of snapper made for the other site apply here also. In addition barracoutta provides another restraint, for this fish is rare inshore other than in the summer and autumn.

An attempt was made here also to determine the season in which the *Chione* shells had been collected. Nine shells were sectioned, three of which were found to be infested with a shell borer which appears to cause irregular growth and thickening of the shell. The other six were thinner and uninfested and show a remarkably similar patterning of the black bands. The sequences of bands all terminated at a similar point after a small amount of growth had taken place after the last band. It is apparent from other work that these bands relate to the winter interruption to growth. Consequently the growth termination in these shells suggests spring or early summer as a likely period of collection.

Use of the site through spring and summer seems to be indicated but again no proof can be offered that the site was not used in the autumn or winter.

DISCUSSION

This site would seem to have served as a base for food preparation, the food being gathered predominantly by shellfishing, fishing and birding. Specialised sites such as this midden have conventionally been placed late in the North Island sequence. Stratigraphically this is born out at Tairua (N44/2) and Ponui (N43/1). The dune middens at Horowhenua (Adkin 1948, p. 39) also support this late dating. Negative evidence from the rarity of extinct birds or Archaic artifacts among the rare artifacts from specialised middens furnishes additional support.

Within the limitations of the environment in this bay no drastic changes in exploitation of its food resources could be anticipated. The economic differences between this site and the western midden are not great but they are still distinct. The change in emphasis towards shellfish, and smaller shellfish, at the expense of fish and birds together with a greater use of the variety of fishing methods favour a different and later dating for this midden than the western midden. The differences in the obsidian assemblages support this contention.

The only artifacts of diagnostic value are the two *Dentalium* sections. Certainly they mostly occur in early assemblages but Green suggested their use persisted quite late (Green 1963, p.58). Their presence on a Classic site would, however, be surprising. While there is a risk that the example from A-2 in the site originated from the lower lens, and could be considerably earlier than the layer 1 midden deposit, this cannot be the case for that from square B-1.

Thus no strong conclusions can be reached but on the evidence above some date later than the western midden must be preferred.

The line of post holes suggests a windbreak against the wind from the exposed bay. The wind rose on Fig. 51 shows that while this is not a prevailing direction for wind it is not an uncommon direction either. If such a wind break was present while the midden was being formed however it would be expected that the midden would be more concentrated to one side of it. This is not the case, suggesting rather that the structure was an open wall. A fish drying rack or a cooking or canoe shelter are possibilities. Either of the latter would probably require a second wall either on the eroded seaward side or in the unexcavated area on the landward side.

Clearly this was a specialised site where fish and shellfish were cooked in the shelter of some kind of structure, but its relationship to other contemporary sites is not known.

The evidence of seasonality does not force a conclusion that the site was *not* used at any particular time of the year. Its manner of use could well have been continuous in conjunction with dwelling sites within a few minutes walk, or it could have been irregularly or seasonally used, perhaps on a daily basis, by people resident some distance away. Much of the midden material in the bay front must relate to the pa and pit and terrace sites behind the bay and this particular site is more likely to be related to nearby sites than to an external site.

The Pa Site, N30/3

On a low ridge above the eastern midden (Fig. 1) is the third site excavated, a small pa (Fig. 52). The site is grass-covered and the only features to be seen, the pit and the trench, are both clearly defined. To the west the ridge continues and a mantle of sand blown up from the beach may conceal more of the site. As shown on the plan, the pit and the defensive trench were investigated, five squares being excavated in all.

STRATIGRAPHY

The stratigraphy of the pit (Figs. 53, 54) proved complex. Layers, from the surface were:

Layer 1: Turf and topsoil.

Layer 2: Black matrix with shell and bone inclusions.

Layer 2a: As 2 but no midden.

Layer 3: Mixed material of black, grey and yellow colouration and inclusions of charcoal.

Layer 3a: A lens of bright yellow clay within layer 3.

Layer 4: Yellow clay.

Layer 4a: Yellow-brown sand overlying layer 4 at one point.

Layer 4b: Lens of grey material within layer 4.

Layer 4c: Lens of black burnt material and charcoal within layer 4 and belows lens 4b.

Layer 5: A sand layer on the floor of the pit with inclusions of burnt fern-tree trunks.

Layer 6: Natural.

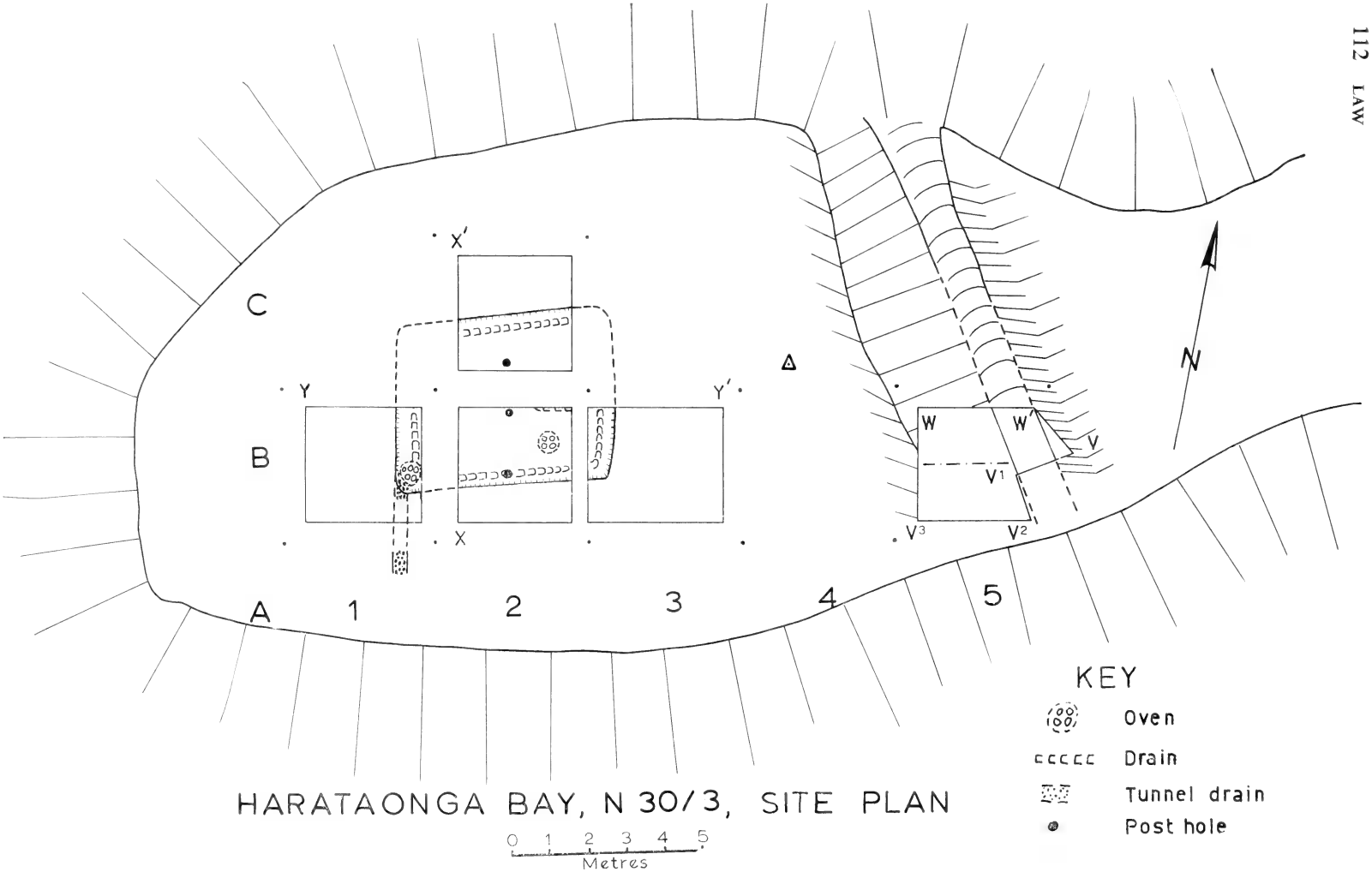


Fig. 52. Site plan N30/3, the pa site.

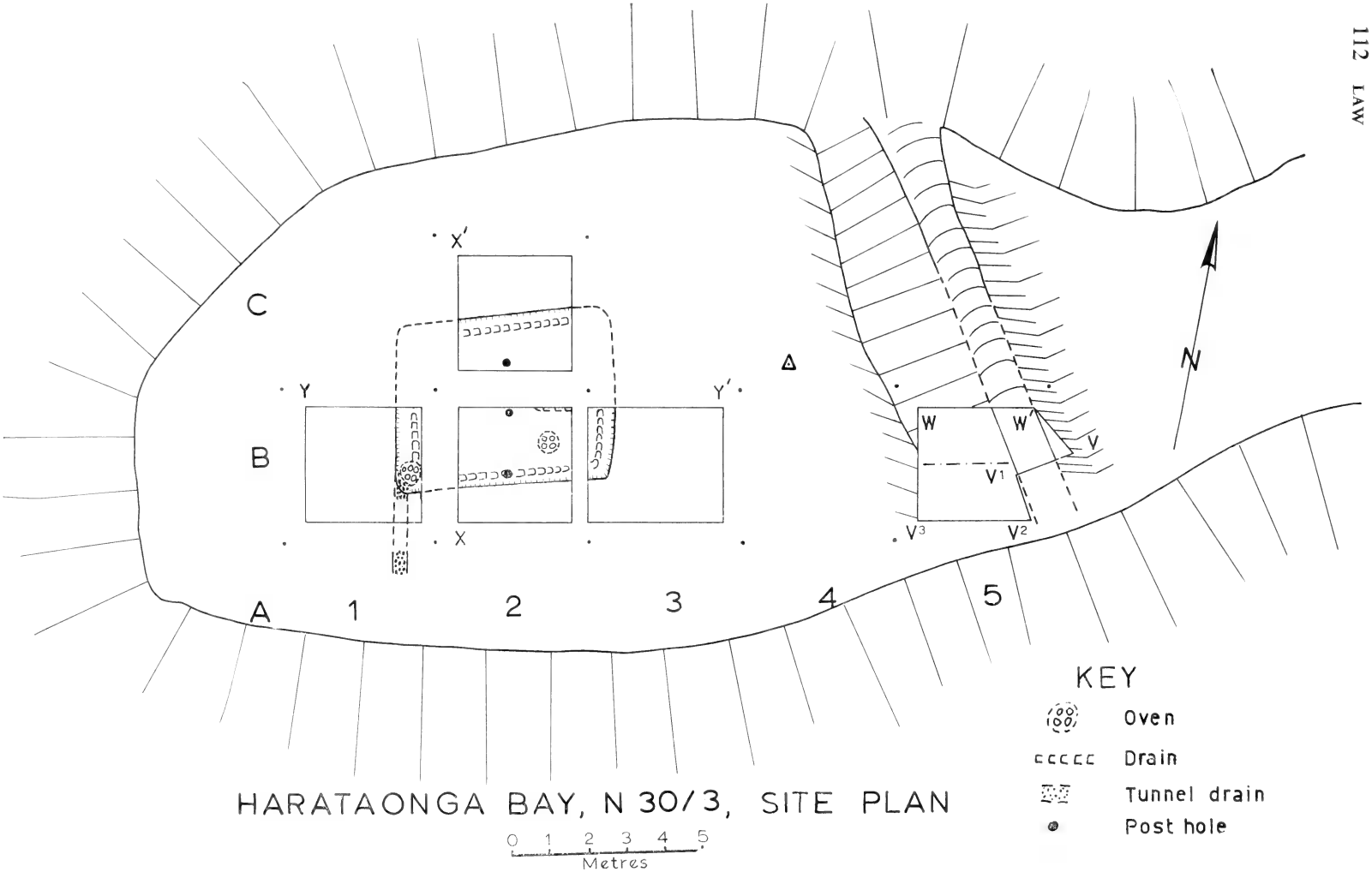
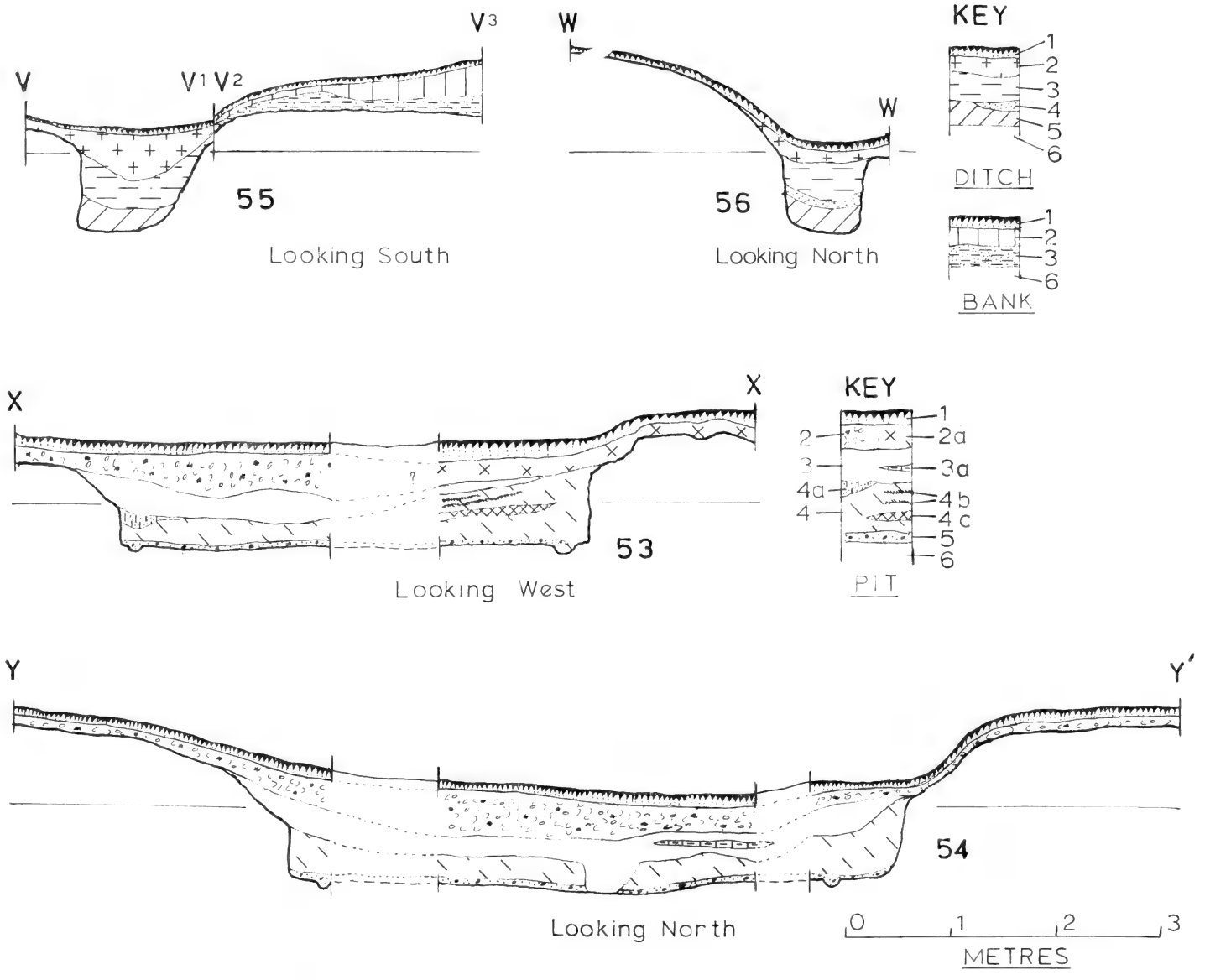


Fig. 52. Site plan N30/3, the pa site.



HARATAONGA BAY N30/3, SECTIONS

Figs. 53-56. Sections for site N30/3. For locations see Fig. 52.

Two ovens were found dug from the surface of layer 4.

The sections through the ditch were simpler (Figs. 55, 56). From the surface the stratigraphy in the ditch was:

Layer 1: Turf and topsoil.

Layer 2: Dark brown soil with flecks of yellow clay.

Layer 3: Yellow-brown soil with large inclusions of yellow clay.

Layer 4: Dark brown with fine flecks of yellow clay.

Layer 5: Dark brown soil but with more abundant yellow clay.

Layer 6: Natural.

In the low bank the following layers were encountered:

Layer 1: Topsoil and turf.

Layer 2: Yellow clay consisting of hard lumps in a soft matrix.

Layer 3: Dark brown soil with flecks of yellow clay.

Layer 6: Natural as elsewhere.

STRUCTURES

The pit on excavation proved to be rectangular with a wall drain and possibly a central drain though this was only partly excavated. The wall drain led to a sump which was drained through a tunnel to the outside slope. Three post holes were found, 16 to 21 cm deep. They were in line along the short axis of the pit. Conventionally rows of posts in pits are along the long axis suggesting that a double row of central posts and occasional wall posts may be the pattern in this pit. The missing posts may be under the baulks. Alternatively, in a pit close to square in plan, a ridge along the short axis is a reasonable method of roofing. No other structures were recognised in the limited flat areas excavated beyond the pit.

The defensive trench was steep sided and flat bottomed. No evidence of palisade posts was found in the limited excavation through the trench and bank.

ARTIFACTS

With the exception of obsidian flakes, artifacts were rare on this site. One worked piece of dog mandible was found as well as six worked fragments of albatross limb bone. A spall from a basalt boulder, a piece of fossilised wood, a piece of kauri gum, six pieces of red and orange ochre and 18 flakes of a variety of siliceous material completed the assemblage. Unlike the western midden, obsidian flakes were more common than siliceous flakes. As well as the process of replacement of Mayor Island obsidian by local obsidian sources, local obsidian appears to have replaced other siliceous materials.

The obsidian included Mayor Island and grey obsidian, the latter most probably from the local sources. All the obsidian except three pieces was from layer 1 of the pit and the immediate area of the pit. The majority of the obsidian flakes were from square C 3, but some flakes came from all squares. The proportion of green Mayor Island obsidian from square C 3 on a flake count was 30 % as against 14 % from the aggregate of the other squares. The comparable figures for weights are 23 % and 6 %. For the total obsidian assemblage the figures are 21 % Mayor Island by flake count and 15 % by weight. The variation from square to square is statistically significant at a 5 % level (Chi squared on flake numbers). In view of the proven variation of the percentages from square to square, the figures for the site as a whole must be regarded as of limited accuracy, as the area excavated may not be representative.

Figure 57 shows flake weight distribution curves for the flake material from this site. The range in sizes is again large as it was at the western midden but some important differences do emerge. Whereas at the western midden the various materials all had very similar curves, here the obsidians are clearly separated from siliceous flakes by their smaller size, which is also smaller than at the western midden. This would suggest that smaller flakes of obsidian were being deliberately used here, possibly to economise

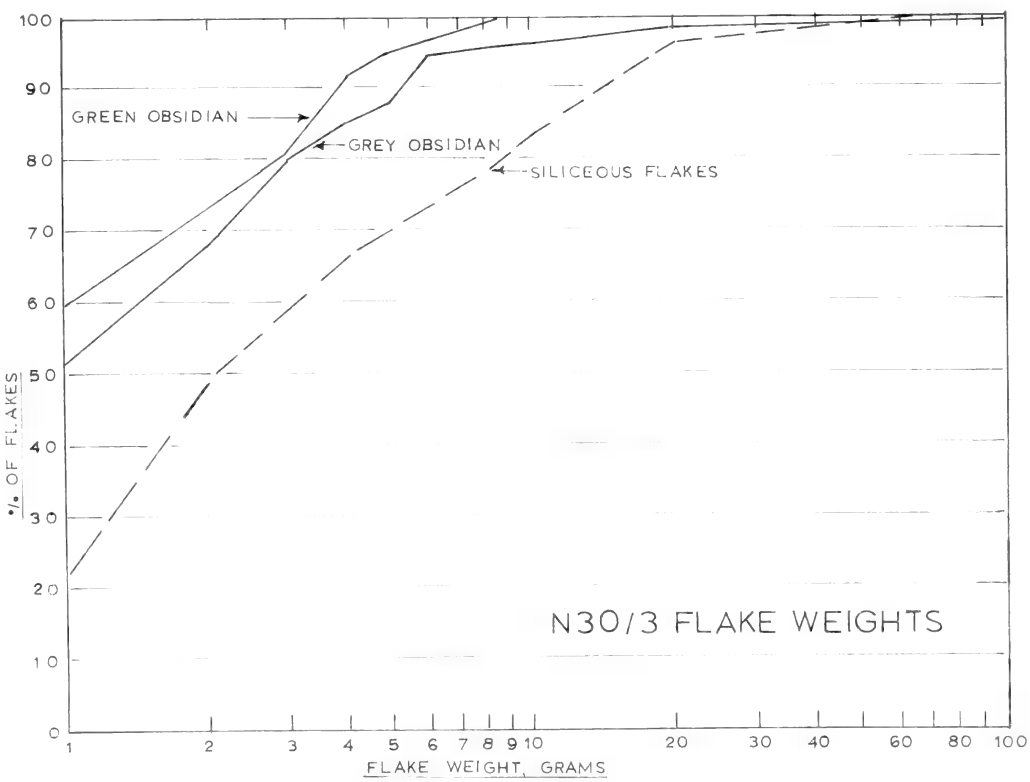


Fig. 57. Flake weight distribution curves for N30/3.

on raw material or because a greater control had been gained over this material. In view of the proximity of the source, the latter seems more likely.

All the flakes were simple conchoidal flakes, without retouch, and some of the obsidian flakes showed use flaking on the edges. It was noticeable that more of the grey obsidian showed the weathered exterior of the primary raw material. The range of siliceous materials appears similar to the western site, but relative to obsidian, much less frequent. Taken on flake count the change in proportion of the sources of obsidian is compared to N 30/5 highly significant (Chi squared) and compared to N 30/4 significant (binomial theorem). The lower frequency of siliceous flakes here was also highly significant when compared to N 30/5 (Chi squared) but there was no significant difference from N 30/4.

The material recovered is recorded in Table 10.

Table 10. Artifactual material in N30/3.

	No.	Wgt. (g)
Mayor Island obsidian	37	52.3
Other obsidian	131	305.1
Unidentified	3	6.1
Flakes, various siliceous materials	18	150.4
Kauri gum	1	2.0
Ochre	6	18.6
Fossilised wood	1	4.4

FAUNAL REMAINS

Shellfish

Shell material in this site was severely weathered, owing no doubt to more acid soil conditions than in the sand at the other two sites. Many of the shells disintegrated on disturbance but a collection of individual shells made during the excavation included the following species: *Amphidesma australe, Amphidesma subtriangulatum, Chione stutchburyi, Haustrum haustorium, Cookia sulcata, Lunella smaragda, Neothais scalaris,* chiton and *Protothaca crassicosta.* The majority of the shell came from layer 2 of the pit fill.

The presence of *Aphidesma* and *Chione* indicates the continued use of shellfish from beyond the immediate area of the site. The other species are all of local occurrence and well represented in the other middens excavated.

Birds and mammals

A mere 25 fragments of bone were recovered from this site and the majority of these cannot safely be concluded to be anything other than industrial waste. Dog was represented by pieces of the mandible alone, the most useful portion for hook manufacture, and seal by one fragment of bone

and three of teeth. Albatross bone was present and all was worked. One cat cranium was taken from the top of layer 2 of the ditch fill. Wild cats occur on the island and this is probably an example.

The species are as follows. Mammals: *Canis familiaris,* (Polynesian dog), *Felis catus,* (Cat), *Arctocephalus forsteri,* (Fur seal), Whale (species not determined). Birds: *Nestor meridionalis septentrionalis,* (N.I. Kaka), *Diomedea* sp. (Albatross).

Fish

Fishbone was rare on this site. In nine identifications the following species were identified; snapper, leather jacket, possible butterfish, possible carangid, and kahawai. As with all the faunal material from this site numbers are insufficient to make any meaningful comparisons with the other sites. Given the fish at the other two sites, none of these identifications is in any way surprising.

SITE HISTORY

A fairly complex history is indicated for the pit and its fill. During the life of the pit, a layer of sand, layer 5, had arrived on the floor. While this sand could have blown in from the beach below (sand is still being blown over the site), it could have been a layer deliberately placed in the pit. The profile adopted by the sand is consistent with the latter. A similar layer has been found in pits at Sarahs Gully, and a sand layer is still used in some modern kumara pits. Burnt pieces of punga (tree-fern) trunks have become mixed with the sand. Punga trunks have been recorded as a pit lining by ethnographers. Layer 4 overlying the sand is of very loose consistency and of fairly even depth over the floor, suggesting it did not arrive in the pit by any natural process. The two oven depressions were dug in the surface of this layer and this probably resulted in the other disturbances to layer 4, and the ash and charcoal lenses in the top, namely layers 4 b and 4 c. Layer 3 could not have been similarly placed and must represent some period of time in which natural infilling was taking place with the walls of the pit being broken down.

Layer 2, a diffuse midden layer and layer 2 a represent a cultural accumulation, possibly placed in the pit to level the site. Outside the pit, layer 2 a may be a natural soil horizon. Layer 1, the topsoil, has formed from layers 2 and 2 a since the site's abandonment. The stages in the pit, then, are first the construction and use of the pit, followed by its infilling, possibly deliberately, and the use of the infilled area first for cooking and then later as an area where food, waste, industrial waste and flake material were deposited.

The sequence in the ditch cannot be absolutely correlated with the pit fill. Layer 5 is probably immediate "roll in" infill and layer 4 possibly a paleosol, but alternatively layer 4 could be a local area of puddling as it does not occur in the other section. The surface of layer 3 in the section 1 - 2 suggests that it too is a natural fill layer. Layer 2 is probably both a natural soil layer outside the ditch and a layer of slower natural infilling and weathering in place within the ditch.

The section 3 - 4 through the low bank is difficult to interpret. Probably layer 3 is a paleosol and layer 2 consists of material deposited from the excavation of the ditch. Layer 3 here is similar to layer 2 in the ditch. The ditch could be correlated either with the pit construction or with the later midden deposit or it may have continued in use through both the pit's use and the site's later use. The absence of occupation material under the bank might argue for an earlier construction.

The possibility that the pit was undefended when it was built is not unlikely as this type of situation is a favoured one for undefended pit sites on this northern coast.

DISCUSSION

Regardless of whether the pit was part of the defended site or not, the site as a pa can only be regarded as an unusual example on account of its small size, and its weak defence. Other pa as small as this, with room only for 3 or 4 pits or houses, do occur. Two notable examples were figured by artists on Cook's voyages. These however together with six of a similar size or smaller, known to the author from Northland, all have the distinguishing characteristics of exceedingly strong defence formed by cliffs on all or almost all sides. It would appear that generally when a small group chose to be self-sufficient in defence they relied a good deal on nature as an aid to fortification. A weak fortification such as this site would seem to leave its few inhabitants at a large tactical disadvantage against any enemy numbering in tens of warriors.

It is as difficult to conceive circumstances when weak fortifications would be required to combat some social friction less than total war, as it is impossible to believe fortifications ever evolved through some type like this.

The various activities revealed by the excavation suggest that this was a fairly generalised site, used for food storage, defence, cooking and some working of stone and bone. Even so, the range of activities is smaller than at the western midden. All these activities were not contemporary, since the storage predates the cooking and material working in the excavated area. The small amount of midden material could represent at most only a few meals for a few people, far less than the potential kumara storage capacity of the pit. This has a below ground volume of 22.5 cubic metres, which at 130 $\pm$ 55 % person days per cubic metre (Law MS) provides 1300 - 4600 person days of food. This calculation allows for unused pit volume, losses in storage, seed tubers, variability of the calorific requirement of a population and of the calorific value of kumara. Beside these figures the later midden on the site is insignificant. This site seems to demonstrate a sequence from a specialised storage site, possibly defended, to a cooking and material working site, also possibly defended. In its later stage this site may have resembled site N38/30 on Motutapu Island (Leahy 1970) which was a pit and terrace dwelling site with evidence for many activities. Few of these sites have been investigated but it appears they were more generalised than the more frequently investigated late middens, pa and pit sites.

Even so, this site in whole or part is more specialised than the western midden and a later date must be preferred.

With agriculture definitely present, users of this site must have been in residence at least occasionally for a large part of the year to grow and consume the crop. No other clear seasonal indicators have been recognised.

Summary and Discussion

Ideally, it is desirable to order these sites through time by some culture-free chronometer such as obsidian rims. This leaves any culture change which occurs as an unquestionable conclusion. Unfortunately, only one site, the western midden, is at all closely dated by such means. The other two sites have been assigned to a later date on the cultural grounds that they are more specialised, and by an obsidian source utilisation chronology (at least by Green 1964). This was done on the basis of previous experience of other sites. Any conclusions which may then be drawn about cultural change through time to specialised sites are strictly speaking, circular arguments. If, however, the hypothesis of greater specialisation leads to a sequence of other cultural variables, which supports and endorses greater specialisation, then greater specialisation attains greater standing as a proven fact rather than as a hypothesis. Green's use of specialisation among other criteria (Green 1963) to order sites produced many convincing relationships. In the Harataonga case the data are much poorer than were available to Green and external evidence must be adduced to support the hypothesis of greater specialisation. Certain conclusions are possible however.

Figure 58 shows diagramatically the differences in some of the faunal remains between the sites. It is worth emphasising that as the sites are so close together they all existed in a single environment and differences between the sites can be expected to be significant. The bottom diagram illustrates the differing characters of the sites, the western midden N30/4, remarkable for its artifacts, the eastern N30/5, for its shellfish, and the pa N30/3, for its relative lack of both artifacts and faunal remains. These represent well the extremes in North Island archaeology.

In the first place there is a decided change of protein diet from emphasis on fish, birds, dogs and seal to a diet which in its surviving remains, at least, seems to concentrate far more on shellfish. The evidence from the shellfish seems to suggest the earlier inhabitants could afford to be selective, as they ate more of the larger species. The decline in seal and dog can probably be attributed to a limitation in the populations of these animals. Fish remains showed a change from snapper domination to larger numbers of other fish, noticeably leather jackets.

The roles of the important vegetable foods, fernroot and kumara, are hard to assess. The dental wear on the burial excavated may suggest some heavy use of fernroot (Taylor 1963) but its dating is uncertain. The pit on the pa is almost certainly evidence of kumara agriculture, the only such evidence recovered. It is possible that crops were grown by the inhabitants of the western midden but certainly not proved. Overall the evidence is consistent with a larger population in later times which exceeded the capacity of the environment to provide the most palatable and easily obtained protein foods and necessitated the consumption of foods which required more work to procure.

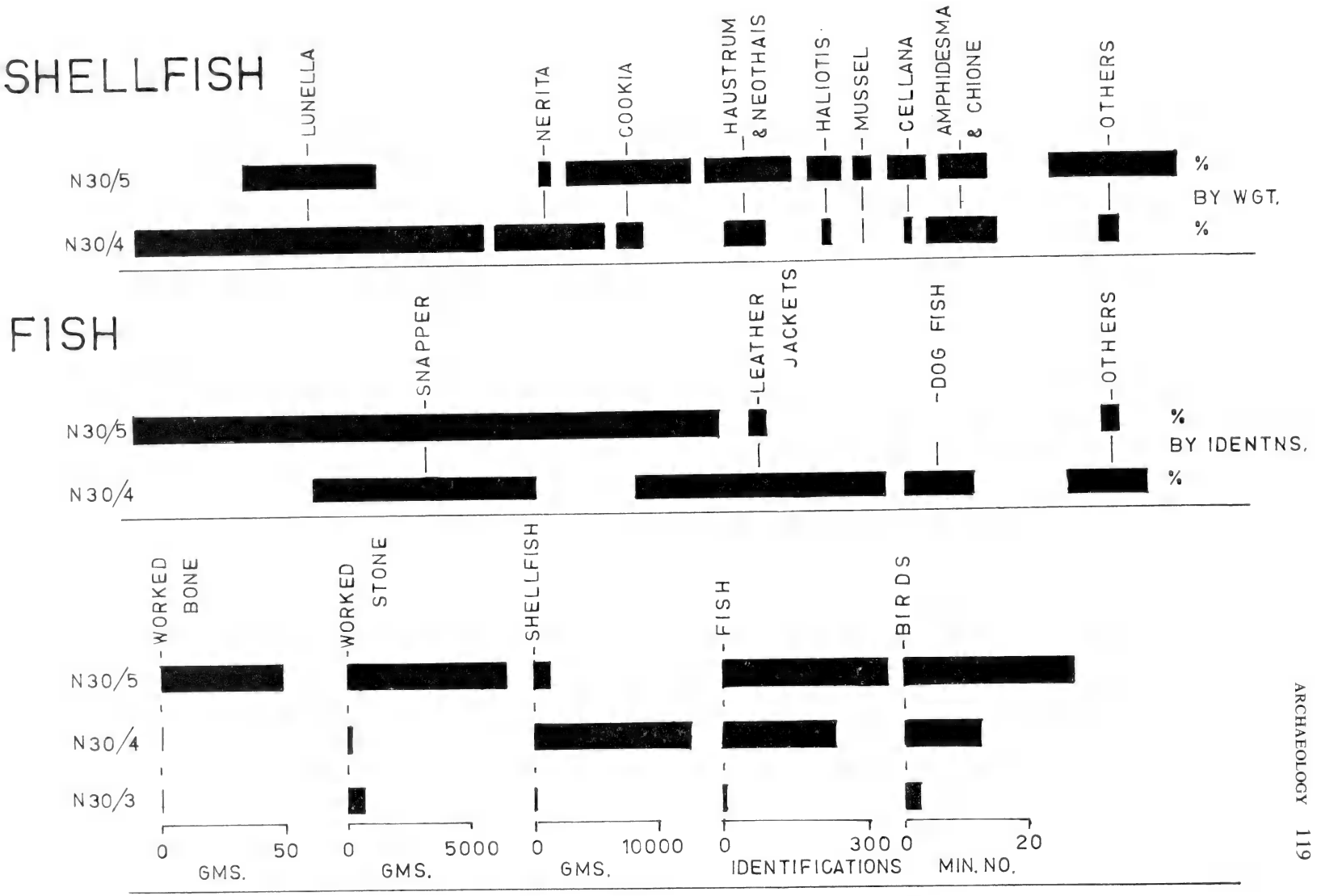


Fig. 58. Inter-site comparisons for shellfish and fish by double lenticular percentage graphs, and for total excavated materials by histograms.

Earlier in this paper it was suggested that the wide range of food used by the inhabitants of the early site argued that it was occupied some time after the initial settlement. Green had previously suggested that a site of his Settlement Phase would exhibit the widest range of native resources (Green 1963, p. 32). A point not stressed by Green is the vast difference between a tropical island environment where the economy was oriented towards agriculture, and the cooler New Zealand environment with marked and economically significant seasons, and the largely exploitational economy of the early cultural phases in New Zealand.

Techniques of tool manufacture and use had to be relearnt for the new raw materials, new bird and fish habitats and methods of procurement would have to be mastered, the palatability tested and a taste acquired for the more exotic foodstuffs. A site truly belonging to a settlement phase must show evidence of this primary adaptation. Such a site could well reveal an economy with many surprising gaps. While this is not generally the case at the western midden, a gap like the absence of trolled fish when compared with the eastern midden, could suggest an area in which new techniques had not yet been developed.

In considering the range of food resources used, therefore, some consideration should be given to early limitations to technique as well as late limitations to supply.

Only a few conclusions can be drawn by comparing the artifactual assemblages. Some changes are apparent in the flake assemblages in the two sites where these were substantial. The importance of siliceous materials compared with obsidian declined markedly in the later sites. Some connection between the siliceous flakes and the drill points at the western midden would make this more explicable. The significant variation in proportion of obsidian from different sources within one layer at the pa site serves as a warning against interpreting significant differences between sites as always reflecting separation in time. The spatial distribution of the flakes on the pa could have arisen from the localised working of a single core of obsidian. In this case, this would be the cause of the statistical significance. With such groups of flakes on sites, valid samples become far larger and have to cover wider areas, to incorporate an adequate number of groups of flakes resulting from the use of one core, if indeed there is on the site an adequate number of such groups. To obtain such samples or to satisfactorily prove that the process of manufacture and loss or waste of flakes was identical for the two or more obsidians will not very often be possible, and must limit the utility of chronological ordering by proportions of obsidian flakes. The flaking of obsidian seems to have become more careful by the time the pa was occupied as it has a higher proportion of small flakes than the early site. Few other differences were apparent on inspection but they may be present, to be revealed by analyses such as that performed by Leach (1969) on assemblages from Murihiku. Certainly no blades or regularly worked cores such as were used in the early South Island appear in the early site. The worked bone on the pa supports a change in the common raw material from moa bone to dog. Although no fishhooks were recognised at the later sites the bone waste was probably from the manufacture of well-known points of two-piece hooks.

The evidence from this bay does nothing to overthrow the often held views on the early unimportance or absence of agriculture and warfare but only in the latter case can these sites lend strong support.

Three phases could comfortably encompass the evidence here, a settlement phase (no evidence, but inferred for the area if not this bay), an Archaic Phase (the western midden), and a later phase, not defined to Classic by artifacts, but Classic by default (the other two sites). At the present stage while there is much of interest in the material from this bay there is little that is revolutionary. Most of it is consistent in dating and character with the statements of New Zealand prehistory made in the past fifteen years, or can be accommodated with minor revisions to the latter. There are only hints of continuity of change in the tool kit, settlement pattern and economy but it would be too ambitious to expect such a full sequence from these sites.

Much of the discussion of New Zealand prehistory lacks an empirical background of published archaeological facts. It is clear from these three very minor sites that even here analysis can produce useful information. Given the data from the major excavations of the last 15 years, New Zealand prehistory could cease to be, as Groube put it, "a just so story".

Acknowledgements. Thanks are due to the Royal New Zealand Naval Volunteer Reserve for transport, the 1962 landowner Mr H. G. Overton for his hospitality, and the members of the Auckland University Archaeological Society for labour. The skilled treatment of the faunal material by Miss J. M. Davidson and Messrs R. J. Scarlett and B. Stephenson deserves special note, as does the detailed cataloguing, sorting and cleaning of the material by Mrs W. Spring-Rice. This paper owes much to criticism in its draft stages by Miss Davidson and Dr R. C. Green, and Mr P. W. Gathercole, of the Pitt Rivers Museum, Oxford. The author would especially like to thank Dr Green for the invitation to work on this material and for a grant for a field visit to Great Barrier Island.

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INDO-PACIFIC NASSARIIDAE (MOLLUSCA: GASTROPODA)

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Abstract. The systematics, shell-morphology, radular anatomy where known, and habitat of 55 Indo-Pacific species of the Buccinacean family Nassariidae are here recorded.

The Nassariidae, a rachiglossate group of species within the superfamily Buccinacea, are a conspicuous and prolific intertidal faunal element of tropical Indo-Pacific reefs and lagoons. The group is cosmopolitan in distribution and some genera live also in temperate waters of major continents. Many species are found in colonies in muddy, clean or weedy coral sand or on reef-platforms, and intertidal species outnumber those from the sublittoral zone.

The animal is moderately large in relation to shell-size and rather agile, and apart from the usual Neogastropod features of tentacles, eyes and proboscis, the rear of the foot generally has a pair of metapodial tentacles. Being mainly carrion feeders, the proboscis is long and capable of great extension. The detailed anatomy of British Nassariidae has been recorded by Fretter & Graham (1962).

TAXONOMY

Towards the second half of the 18th century, species of Nassariidae were included in *Buccinum* Linnaeus, 1758. Subsequent authors either assigned nassarid species to the newly created genus *Nassa* Lamarck, 1799 (non Röding, 1798), or retained them in *Buccinum*. A. Adams (1852 - 1853) published the first catalogue of *Nassa* which was followed by Reeve's (1853 - 1854) first comprehensive world-wide monograph of the genus. Apart from Tryon's last monograph of Nassariidae (1882), no attempt has been made to evaluate the taxonomy of even common species, especially those from the tropical Indo-Pacific region. While some Mediterranean and British Nassariidae have advanced to the beta-level in taxonomy, tropical Indo-Pacific species are at present at the sub-alpha level.

Tomlin's papers on Nassariidae (1932a, 1932b, 1940) are invaluable evaluations of the types of species described by A. Adams, Reeve and Marrat. Shuto (1969) proposed a supraspecific arrangement of Nassariidae based on features of radula, operculum, protoconch, number of metapodial tentacles and egg-capsules. The results obtained during examination of radulae and opercula of Indo-Pacific Nassariidae for this paper, cut in some instances, right across the arrangement proposed by Shuto *(op. cit.)*.

SHELL MORPHOLOGY AND RADULA

Morphological features, particularly those of shell and operculum, are extremely variable, but probably no more or less than in other groups of rachiglos-

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sate gastropods. Similarly to the Mitridae, species of Nassariidae come in broad and slender forms, with a sculpture which may persist to the body whorl or become obsolete on the last 2 - 3 whorls. These slender and broad forms and sculptural variants have been mainly responsible for the overnaming in this group. Great stress has been put on the size and expansion of the columellar callus-shield in Nassariidae, a feature which is highly variable and not always reliable as a diagnostic feature. The size of the columellar shield depends on the developmental stage of the individual: juvenile specimens of species with a large callus-shield, e.g. *N.arcularius* (Linnaeus), lack the shield completely, but mature adults display a wide, flaring shield. In certain populations of the species, the callus-shield does not even reach the body whorl suture in mature specimens.

The shape and serrations of the operculum have been found to be variable to a high degree and of little use as a diagnostic feature (Fig. 1). *Nassarius (Plicarcularia) graniferus* (Kiener), generally has an operculum with a serrated margin, but in certain individuals the operculum is smooth.

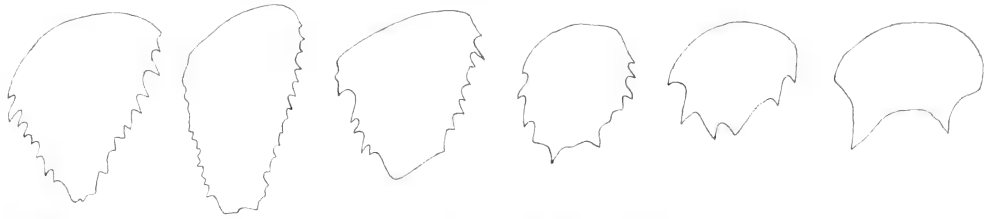


Fig. 1. *Nassarius arcularius arcularius* (Linnaeus). Kakula I., New Hebrides. Variation in outline of opercula.

The radula of Nassariidae is typically Buccinacean, consisting of 3 teeth per row, and occasionally an additional small, ovate to trigonal, cuspless plate which is interposed between the rachidian and lateral tooth, and partly overlapped by the latter. This small plate was recognized by Troschel (1867), who called it the "accessorische Platte", and for want of a better term will be referred to as the accessory lateral plate. A similar plate of unknown function has been recorded in the taenioglossate ovulid genus *Pedicularia* Swainson. Troschel *(loc. cit.)* was not quite certain whether the accessory lateral plate was a rudimentary lateral, in which case the actual lateral would become the inner marginal, or if this plate is an inner, degenerate lateral tooth. From a structural viewpoint, the small accessory plate would make an excellent pivoting point for the laterals, but would not account for the variation in size and shape, and random presence or absence among related or even identical species of Nassariidae. The real function and origin of the accessory lateral plate remains obscure.

Troschel *(loc. cit.)* remarked that the radulae of Nassariidae he examined were all so similar in basic characters, and on the basis of the radula, there appears to be no reason to separate the various groups generically. Radular studies of Indo-Pacific Nassariidae tend to confirm Troschel's contention, with the sole exception of 2 species of the genus *Hebra* H. & A. Adams. *H.horrida* (Dunker) and *H.subspinosa* (Lamarck), have a radula which differs widely, particularly in the form of laterals, from the stereotyped pattern of tropical Nassariidae (Figs. 94-96).

The species of Indo-Pacific Nassariidae treated in this paper have been assigned to their respective genera or subgenera on shell-morphology, and *Hebra* is acknowledged as a distinct genus on the basis of a divergent radula.

Order NEOGASTROPODA

RACHIGLOSSA

Superfamily BUCCINACEA

Family NASSARIIDAE Iredale, 1916

1840. Nassinae Swainson, Treat. Malac., pp. 63, 69, 299 (not available, art. 39 of ICZN).
1871. Nassininae Gill, Smiths. Misc. Coll. 10 (2): 5.
1871. Cyclonassinae Gill, Smiths. Misc. Coll. 10 (2): 5.
1901. Dorsaninae Cossman, Ess. paléoc. comp. 4: 195, 197.
1908. Alectrionidae Dall, Bull. Mus. Comp. Zool. Harv. 43: 306.
1916. Arculariidae Hedley, J. R. Soc. W. Aust. 1: 61 (on cover "publ. August 1915", date at bottom is 1916).
1916. Nassariidae Iredale, Proc. Malac. Soc., Lond. 12: 82.

Usage of the family name Nassidae has to be abandoned because of homonymy of the type-genus *Nassa* Lamarck, 1799 (non Röding, 1798). Although several chronologically prior family-group names are in existence, the family name Nassariidae has been almost universally adopted during the last 40 years by malacological writers. Some of the earlier names, particularly Dorsaninae, may be utilized in a subfamilial arrangement of the group, and a petition for the preservation of Nassariidae is before the Commission on Zoological Nomenclature.

The subfamily name Truncariinae erected by Cossmann (1901) in the Nassariidae and based on *Truncaria* Adams & Reeve, 1850, should be transferred to the Buccinidae.

Genus **Nassarius** Duméril, 1806

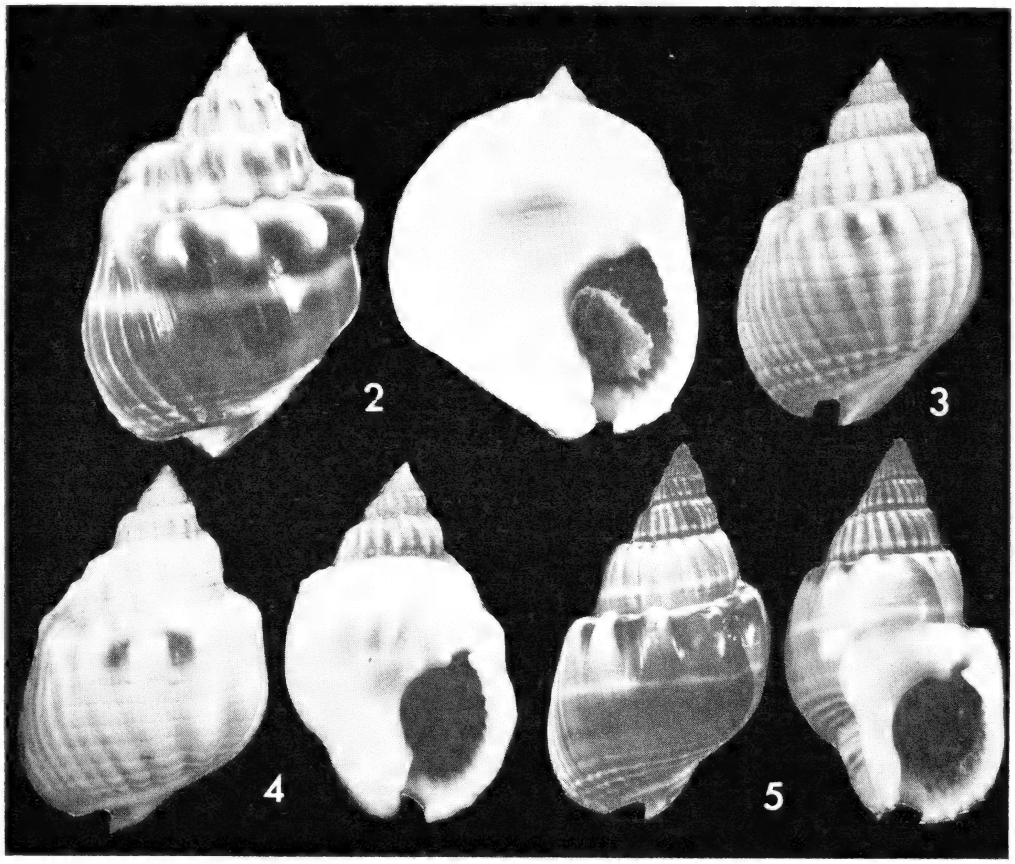
Nassarius Duméril, 1806, Zool. analyt. p. 166. Type species by SM (Froriep, 1806) *Buccinum arcularia* L. = *B. arcularia* Linnaeus, 1758. Recent, Indo-Pacific.
1807. *Arcularia* Link, Beschr. Nat.-Samml. Univ. Rostock p. 126. Type species by SD (Mörch, 1863) *A. coronata* Link, 1807 (non Bruguière, 1789) = *Buccinum arcularia* Linnaeus, 1758.
1828. *Nasa* Fleming, Hist. Brit. Anim. p. 340 (inv. emend.).
1933. *Acicularia* Dautzenberg & Bouge, J. Conchyl. 77: 213 (*nom. null.*).

Shell moderate in size, 20-35mm in length, whorls convex or angulate, sculptured with axial ribs and spiral threads, columella calloused and expanded laterally, anteriorly denticulate; outer lip dentate, aperture lirate, siphonal canal short and notched. Operculum corneous and serrate at margin, radula with laterals consisting of 2 single cusps, accessory lateral plate present.

Iredale (1916) considered *Nassarius* Duméril to be a substitute name for *Nassa* Lamarck, 1799. No evidence can be found in Duméril (1806) that his *Nassarius* has been proposed as a substitute name, and *Nassarius* is considered a genus without included nominal species, with the type *Buccinum arcularia* Linnaeus, by subsequent monotypy of Froriep (1806).

Recent authors use *Arcularia* Link, 1807, as a subgenus of *Nassarius*, on the basis of Cossman's (1901) designation of *Buccinum gibbosulum* Linnaeus,

1758, as the type of the genus. An earlier designation by Mörch (1863) of *Arcularia coronata* Link, 1807 (non Bruguière, 1789) as the type species of *Arcularia,* makes the latter an objective synonym of *Nassarius*. The Mediterranean species *N. gibbosulus* would be appropriately placed in *Plicarcularia* Thiele, 1929. *Nassa* Lamarck, 1799 (non Röding, 1798) and *Nassaria* Rafinesque, 1815 (non Link, 1807) are synonyms of *Sphaeronassa* Locard, 1886, with *Buccinum mutabile* Linnaeus, 1758, as its type.



Figs. 2-5. 2. *Nassarius arcularius arcularius* (Linnaeus). Port Havannah, New Hebrides; 24.0mm. 3-5. *N. arcularius plicatus* (Röding). 3. Mnemba I., N.E. Zanzibar; 20.0mm. 4. Pt. Mahatsinjo, S. Nossi-Bé, Madagascar; 22.0mm. 5. Ceylon; 36.0mm.

Nassarius arcularius arcularius (Linnaeus, 1758) (Figs. 2, 19)

1758. *Buccinum arcularia* Linnaeus, Syst. Nat. ed. 10: 737.

1773. *"Galeodes Arcularia major"* Martini, Syst. Conch. Cab. 2: 89, pl. 41, figs. 409, 410 *(non binom.).*

1798. *Distorsio arcularia* Röding, Mus. Bolten. p 133 (Ref. Martini, figs. 409, 410).

1807. *Arcularia coronata* Link *(pars),* Besch. Nat.-Samml. Univ. Rostock, 3 Abth: 126 (ref. Martini, figs. 409-412 [non *Buccinum coronatum* Bruguière, 1789].

1816. *Nassa arcularia* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 394, figs. 1a, b.

1833. *Buccinum arcularia* Lamarck, Quoy & Gaimard, Voy. L'Astrolabe 2: 438, pl. 32, figs. 1-4 (animal).

1834. *Buccinum arcularia* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 94, pl. 28, fig. 115.
1853. *Nassa arcularia* Linnaeus, Reeve, Conch. Icon. 8: pl. 4, figs. 25a, b.
1956. *Buccinum arcularia* Linnaeus, Dodge, Bull. Amer. Mus. Nat. Hist. 111: 190.

Shell 18-30mm in length, sculptured with coarse axial ribs which number from 12-14 on the penultimate and from 16-20 on the body whorl; ribs become thin, numerous and crowded on the back of the outer lip. Interstices smooth, base with 4 spiral cords overriding axial ribs. Columellar callus large and spreading to either the body whorl or penultimate whorl suture; anal canal "U"-shaped, interior of aperture prominently lirate, anterior of columella with 3-6 small denticles. Creamy-yellow, sometimes with a broad brown band on the body whorl and dark brown spots between sutural coronations; interior of aperture uniformly creamy-yellow or banded with purple-brown. Operculum serrate at the margin.

TYPE LOCALITY: None.

HABITAT: In coral and weedy sand, intertidal.

Material examined: Haapai, Tonga I.; Nuku'alofa, Tonga I.; Nananu-i-Ra I., Fiji I.; Levuka, Ovalau, Fiji I.; New Hebrides: Kakula I., Tuki Tuki Pt., Port Havannah and Pango Pt., all Efate I.; Green I., N.Qld., Australia; Soepiori, Schouten I., W New Guinea; Solomon I.

Nassarius arcularius plicatus (Röding, 1798) (Figs. 3 - 5, 20)

1773. *"Galeodes Arcularia major"* Martini, Syst. Conch. Cab. 2: 91, pl. 41, figs. 411, 412 *(non binom.)*.
1798. *Distorsio plicata* Röding, Mus. Bolten. p. 133 (ref. Martini, figs. 411, 412).
1816. *Nassa arcularia* var. *spira cancellata* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 394, fig. 2.
1834. *Buccinum obvelatum* Deshayes in Laborde & Linant, Vol. L'Arabie & Petrée p. 66, figs. 5, 6 (Red Sea).
1844. *Buccinum rumphii* Deshayes & Edwards, Hist. nat. anim. s. vert. 2nd ed., 10: 179 (ref. Martini, figs. 411, 412; Lamarck, pl. 394, fig. 2) [non *B. rumpfii* Gmelin, 1971].
1853. *Nassa pulla* Reeve, Conch. Icon. 8: pl. 4, figs. 22a, b (non *Buccinum pullus* Linnaeus, 1758).
1957. *Nassarius pullus* Linné, Kaicher, Indo-Pacif. sea shells pl. 7, fig. 9 (non *Buccinum pullus* Linnaeus, 1758).

The Indian Ocean subspecies differs from the Pacific form in being spirally striate. The spire whorls have 3-4 finely incised spiral grooves and the body whorl 7-12 grooves. Specimens from Port Sudan, Red Sea, are considerably smaller than specimens from other Indian Ocean localities and average only 17.0 mm in length.

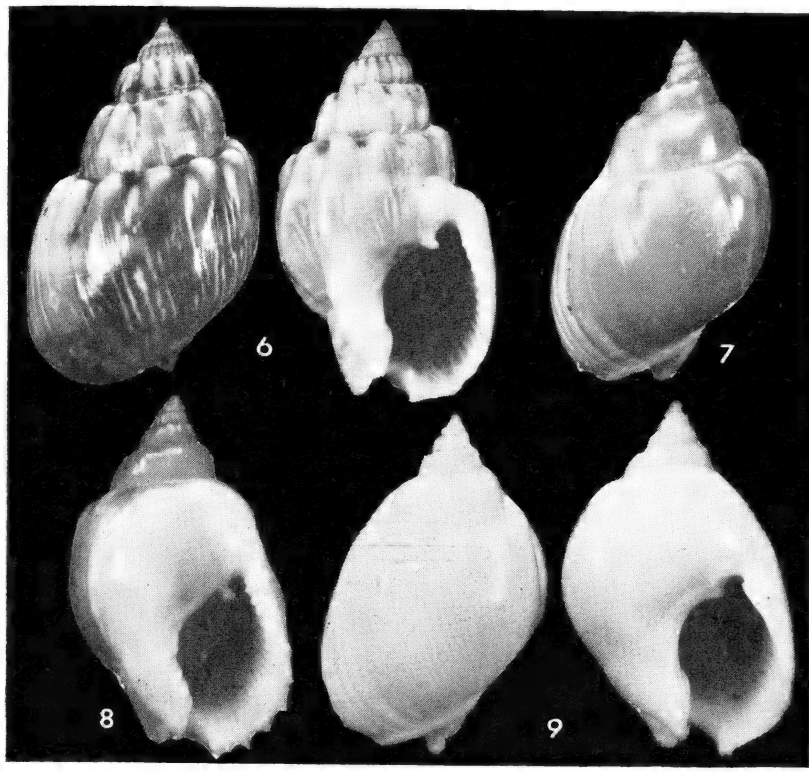
TYPE LOCALITY: None.

Material examined: Tarut Bay, Persian Gulf; Dubai, Oman coast; Port Sudan, Red Sea; Raskamoni reef, Dar-es-Salaam, E. Africa; Mnemba I. and Jembiani, Zanzibar; S. of Nossi-Bé, Madagascar.

Nassarius coronatus (Bruguière, 1789) (Figs. 6-9,21)

1789. *Buccinum coronatum* Bruguière, Encycl. Méth. vers. 1: 277.
1825. *Buccinum coronatum* Bruguière, Wood, Ind. Test. p 106, pl. 22, fig. 41a.

1834. *Buccinum coronatum* Bruguière, Kiener, Spéc. gén. icon. coq. viv. 9: 97, pl. 28, fig. 112.
1849. *Buccinum bronnii* Philippi, Zeit. Malakozool. 5: 137 (non Anton, 1839) [Java].
1851. *Buccinum bronni* Philippi, Abb. Beschr. Conch. 3: 49, pl. 1, fig. 17 (non Anton, 1839).
1853. *Nassa coronata* Lamarck, Reeve, Conch. Icon. 8: pl. 3, figs. 20a-c.
1936. *Nassarius fasciolatus* (Gronovius), Hirase, Coll. Jap. shells p. 75, pl. 105, fig. 1 *(non binom.).*
1959. *Nassa coronata* Bruguière, Barnard, Ann. Sth. Afric. Mus. 45: 109, fig. 22j (radula).



Figs. 6-9. *Nassarius coronatus* (Bruguière). 6. Raskamoni reef, Dar-es-Salaam, E. Africa; 24.8mm. 7, 8. Keppel Bay, Qld., Australia; 28.0mm. 9. Schonian Harbour, Peleliu I., Palau I.; 24.6mm.

Shell 20-36mm in length, similar to *N. arcularius* but differs in the following features: axial ribs on the body whorl are indicated only at the sutures in the form of coronations or elongated crenules, ribs disappearing on lower two-thirds of body whorl; only 4-6 crowded and slender ribs are continuous on the back of the outer lip. Early whorls crenulate but spiral threads becoming obsolete towards the penultimate whorl. Columellar callus smaller than in *N. arcularius* and not expanding laterally. Mature specimens have up to 7 sharp, small denticles on the edge of the outer lip. Creamy-white, golden-brown, greenish-brown or dark brown, frequently with a light coloured, narrow band below the body whorl suture, darker brown between coronations, and with fine, white hair-lines; interior of aperture purple-brown, banded with white. Operculum serrate at the margin.

TYPE LOCALITY: Foulepoint, Madagascar.

HABITAT: In silty and weedy sand, intertidal.

Material examined: Raskamoni reef, Dar-es-Salaam, E. Africa; Kepwani, Zanzibar; Ceylon; Cebu, Philippines; Hongkong; Schonian Harbour, N. Peleliu, Palau I.; Mios Woendi, Padaido I., W. New Guinea; Australia: Kurrimine beach; Magnetic I.; Caloundra; Yorkey's Knob, N. of Cairns; N. Keppel I.; Gloucester I., all Queensland.

Nassarius coronatus does not appear to live in the Pacific Ocean east of Australia.

Subgenus **Plicarcularia** Thiele, 1929

Plicarcularia Thiele, 1929. Handb. syst. Weicht. p. 324. Type species by M *Nassa (Plicarcularia) thersites* Bruguière = *Buccinum pullus* Linnaeus, 1758. Recent, Indo-Pacific.

1826. *Eione* Risso, Hist. nat. Eur. merid. 4: 171. Type species by SD (Herrmannsen, 1847) *Buccinum gibbosulum* Linnaeus, 1758. Recent, Mediterranean. (non *Eione* Rafinesque, 1814.)

1936. *Parcanassa* Iredale, Rec. Aust. Mus. 19: 322. Type species by OD *P. ellana* Iredale, 1936 = *Buccinum burchardi* Dunker in Philippi, 1849. Recent, S.E. Australia.

1955. *Plicularia* Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 7: 2, 4 *(nom. null.)*.

1969. *Retiarcularia* Shuto, Mem. Fac. Sci. Kyushu Univ., ser D., Geol. 19: 23 *(nom. nud.)*.

1969. *Chelenassa* Shuto, Mem. Fac. Sci. Kyushu Univ., ser. D., Geol. 19: 142. Type species by OD *Nassarius (Chelenassa) elegantissimus* Shuto, 1969 = *Nassa bellula* A. Adams, 1852. Recent, Philippines.

Similar to *Nassarius s. str.* but smaller, rarely exceeding 20.0 mm in length, more elongate-ovate, columellar callus generally spreading in a longitudinal direction; aperture rather small. Sculptured with axial ribs and spiral threads, siphonal canal short. The inner cusp of the lateral of the radula has a tendency to become denticulate on the outer cutting edge, but at least two species have simple cusps as in *Nassarius*. Accessory lateral plates are present, and the operculum is serrate at the margin.

Nassarius (Plicarcularia) pullus (Linnaeus, 1758) (Figs. 10 - 12, 24)

1758. *Buccinum pullus* Linnaeus, Syst. Nat. ed. 10: 737.

1789. *Buccinum thersites* Bruguière, Encycl. Méth. vers 1: 279 (Asiatic Ocean).

1816. *Nassa thersites* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 394, figs. 8a, b.

1833. *Buccinum thersites* Lamarck, Quoy & Gaimard, Voy. L'Astrolabe 2: 447, pl. 32, figs. 22-24 (animal).

1834. *Buccinum thersites* Bruguière, Kiener, Spec. gén. icon. coq. viv. 9: 99, pl. 28, fig. 113.

1853. *Nassa thersites* Bruguière, Reeve, Conch. Icon. 8: pl. 10, fig. 65.

1868. *Nassa gracilis* Pease, Amer. J. Conch. 3: 273, pl. 23, fig. 4 (Ascension I., Pacific = Ponape, Caroline I.).

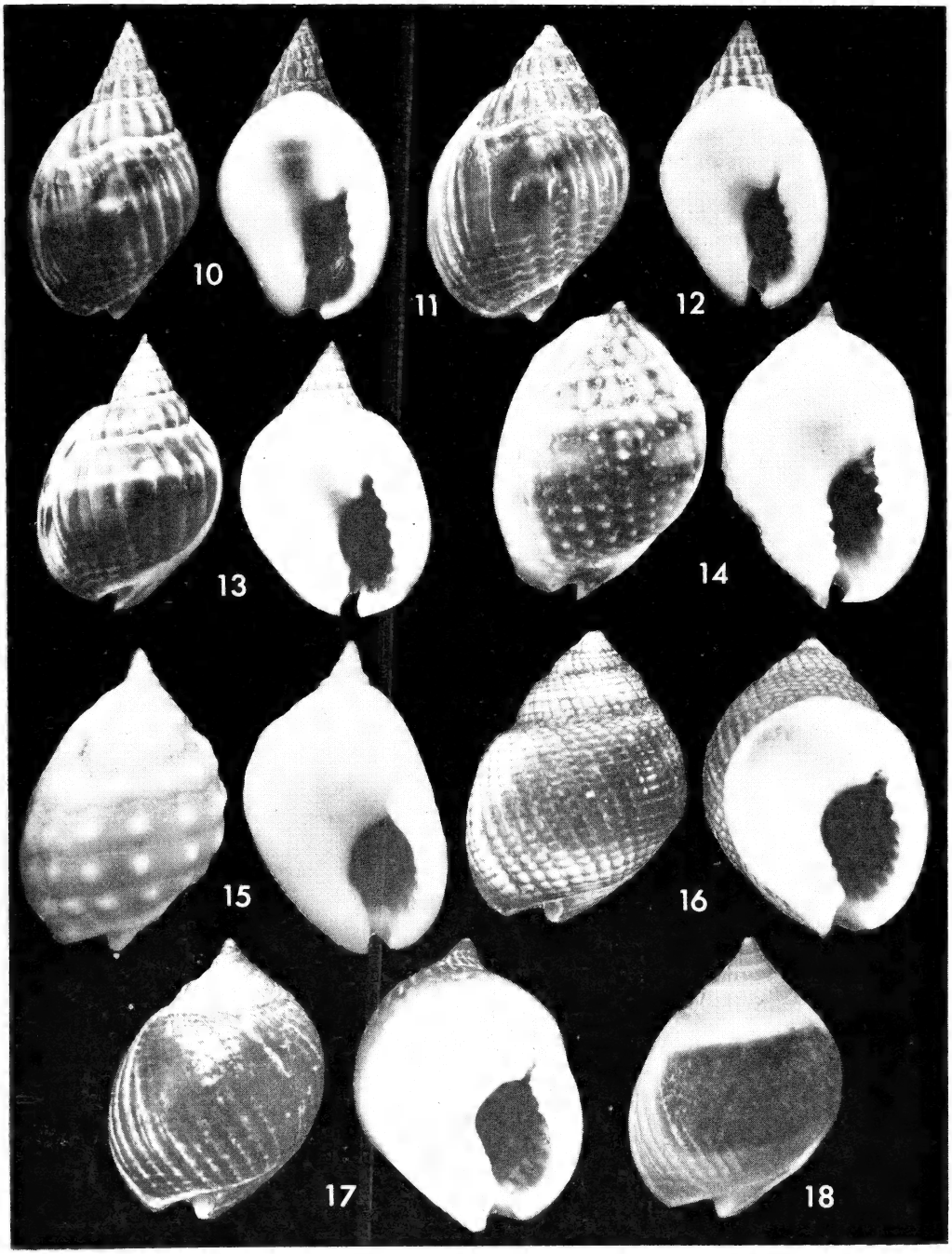
1887. *Nassa thersites* var. *acypha* von Martens, J. Linn. Soc. Lond. Zool. 21: 182, pl. 16, figs 1a-c (Mergui Arch.).

1956. *Buccinum pullus* Linnaeus, Dodge, Bull. Amer. Mus. Nat. Hist. 111: 190.

1957. *Nassarius jonasi* Dunker, Demond, Pacific Sci. 11: 320, fig. 21 (non *Buccinum jonasii* Dunker, 1846).

1967. *Plicarcularia bellula* (A. Adams), Habe & Kosuge, Stand. Book Jap. shells col. 3: 76, pl. 29, fig. 40 (non *Nassa bellula* A. Adams, 1852).

Shell 15-21mm in length, sculptured with slender axial ribs which number from 12-16 on the penultimate and from 11-18 on the body whorl; ribs become obsolete



Figs. 10-18. 10-12. *Nassarius (Plicarcularia) pullus* (Linnaeus). 10. Lucinda Pt., Qld., Australia; 18.3mm. 11. Port Havannah, New Hebrides; 13.0mm. 12. Horseshoe Bay, Magnetic I., Qld., Australia; 21.4mm. 13. *N. (P.) bimaculosus* (A. Adams). Koeroedoi I., Geelvink Bay, W. New Guinea; 17.0mm. 14. *N. (P.) callospira* (A. Adams). Tuki Tuki Pt., New Hebrides; 12.0mm. 15. *N. (P.) graniferus* (Kiener). Manava I., Fiji I.; 17.4mm. 16-18. *N. (P.) globosus* (Quoy & Gaimard). 16. Guadalcanal, Solomon I. Sculptured form; 14.0mm. 17. Tuki Tuki Pt., New Hebrides. Intermediate form; 11.4mm. 18. Smooth form from same locality; 13.4mm.

adjacent to the dorsal hump towards the aperture, but regain their strength on the back of the outer lip. Spire whorls spirally corded, threads becoming obsolete towards the body whorl where on the upper half they appear as weakly impressed striae in interstices and become cords again towards the base. Hump on the centre of dorsum usually prominent but weakly developed in some specimens. Columellar callus prominent, pointed at the top and extending up to one-half of the antepenultimate whorl. Parietal denticle distinct, anal canal narrow, outer lip with 6-11 denticles, interior of the aperture smooth, lower half of the columella with 4-8 small denticles. Brown or greyish-brown in colour, sometimes dark green, body whorl with a narrow band below suture and a darker blotch on the hump; columellar callus yellow or orange, occasionally cream, with a darker pattern showing through above the parietal wall; aperture purplish-brown, banded with white.

TYPE LOCALITY: Mediterranean = error! (Asiatic Ocean — Bruguière, 1789).

HABITAT: In coral and weedy sand, intertidal.

Material examined: Port Havannah, Efate I., New Hebrides; Australia: Lucinda Pt., Qld.; Pt. Martin, Townsville, Qld.; Green I., Qld.; Horseshoe Bay, Magnetic I., Qld.; Soepiori, Schouten I., W. New Guinea; Alligator I., Singapore.

The name *Nassarius pullus* was erroneously applied to *N.arcularius plicatus* (Röding) by several authors until Dodge (1956) unravelled the nomenclatural tangle involving *N.pullus*, *N.thersites* and *N.arcularius*, and advocated the reinstatement of *N.pullus* for *N.thersites*. The existence of a specimen of *N.pullus*, which is the *N.thersites* of authors, in a marked box in the Linnean collection in London, confirms Dodge's conclusions as to the true identity of the Linnaean *pullus*.

Nassarius (Plicarcularia) bimaculosus (A. Adams, 1852) (Figs. 13, 23)

1852. *Nassa bimaculosa* A. Adams, Proc. Zool. Soc. Lond. p. 102.

1853. *Nassa bimaculosa* A. Adams, Reeve, Conch. Icon. 8: pl. 10, fig. 61.

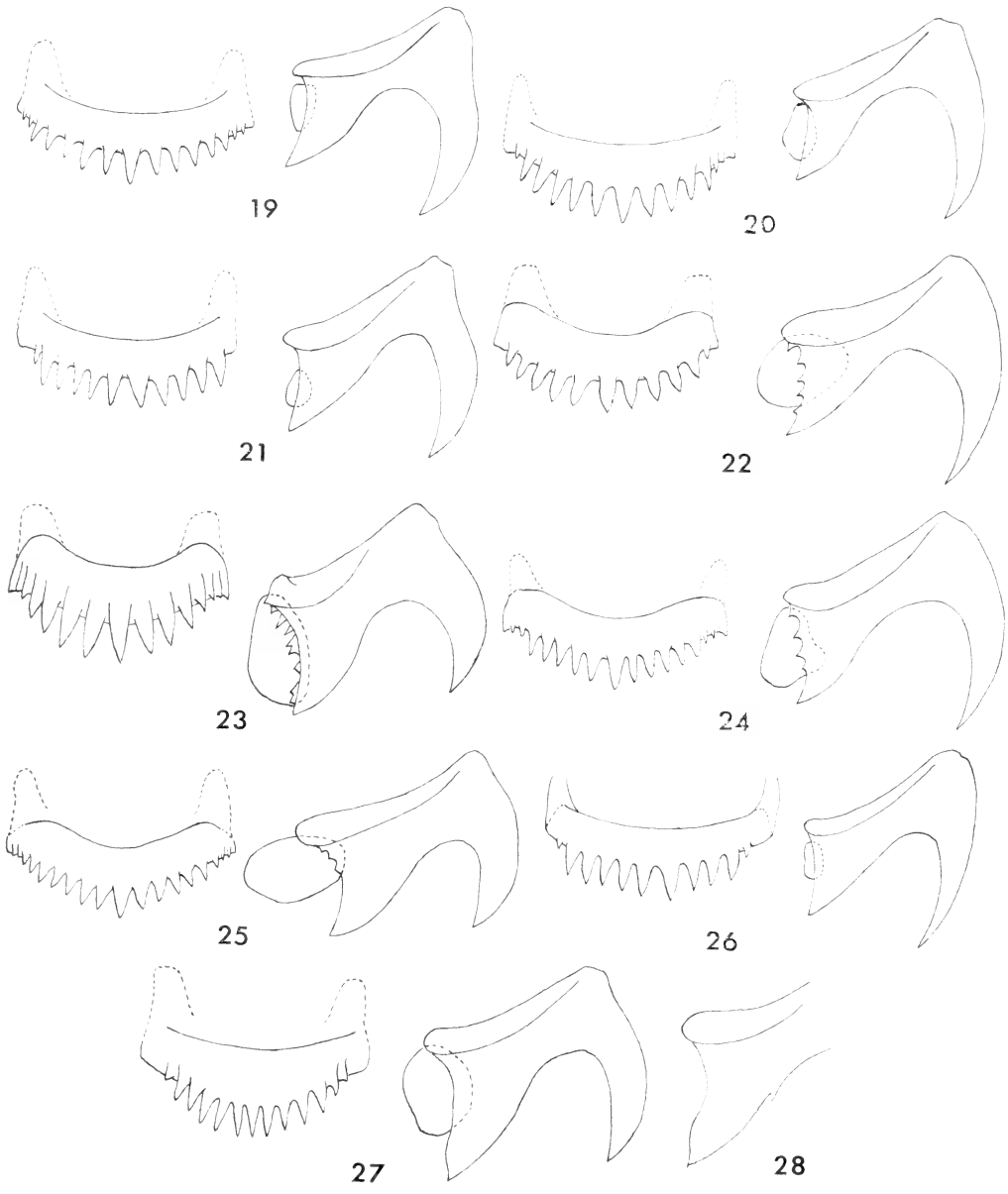
1938. *Nassa (Arcularia) bimaculosa* A. Adams, Adam & Leloup, Mém. Mus. R. d'Hist. Nat. Belg. 2: 182, pl. 8, fig. 5a, b.

1966. *Plicarcularia bimaculosa* (A. Adams), Habe & Kosuge, Shells world col. 2: 61, pl. 22, figs. 20, 21.

Only slightly smaller and similar to *N. pullus*, but differs in the following features: squatter and broader, axial ribs on body whorl wider apart and interrupted below the sutures by a shallow channel giving rise to small sutural nodules; interstices smooth, lacking the impressed lines of *N. pullus*. Columellar callus more orbicular and not pointed posteriorly and always white in colour; dorsal hump smaller and more knob-like and the dark brown blotch present in *N. pullus* is absent. Greenish-grey to bluish-grey, ornamented with a narrow white subsutural band and a darker central band on the body whorl; the back of the outer lip usually with 2 dark brown spots, but some individuals uniformly dark brown in colour.

TYPE LOCALITY: Siquijor I., Philippines.

HABITAT: In silty sand, intertidal.



Figs. 19-28. Half-row of radulae. 19. *Nassarius arcularius arcularius* (Linnaeus). Kakula I., New Hebrides. 20. *N. arcularius plicatus* (Röding). Jembiani, S.E. Zanzibar. 21. *N. coronatus* (Bruguière). Kepwani, Zanzibar. 22. *N. (Plicarcularia) globosus* (Quoy & Gaimard). Tuki Tuki Pt., New Hebrides. 23. *N. (P.) bimaculosus* (A. Adams). Koeroedoi I., W. New Guinea. 24. *N. (P.) pullus* (Linnaeus). Port Havannah, New Hebrides. 25. *N. (P.) callospira* (A. Adams). Tuki Tuki Pt., New Hebrides. 26. *N. (P.) sordidus* (A. Adams). Koror I., Palau I. 27. *N. (P.) graniferus* (Kiener). Manava I., Fiji I. 28. Inner cusp of lateral of *N. (P.) graniferus* from same radula.

Material examined: Kaipoeri, Koeroedoi I., Geelvink Bay, W. New Guinea; Marinduque, Philippines.

Nassarius (Plicarcularia) callospira (A. Adams, 1852) (Figs. 14, 25)

1852. *Nassa callospira* A. Adams, Proc. Zool. Soc. Lond. p. 102.

1853. *Nassa callospira* A. Adams, Reeve, Conch. Icon. 8: pl. 10, fig. 66a, b.

1938. *Nassa (Arcularia) callospira* A. Adams, Adam & Leloup, Mém. Mus. R. d'Hist. Nat. Belg. 2: 183, pl. 8, figs. 6a, b.

Shell 10-13mm in length, spire whorls sculptured with thick and broad axial ribs and spiral threads in interstices; on the body whorl axial ribs become thinner but granulose through overriding spiral cords. Axial ribs number from 8-11 on the body whorl and from 5-7 on the penultimate whorl; on the centre of the dorsum is a small but distinct, longitudinally elongated hump. Columellar shield thick and very large, extending almost to the tip of the spire; the ventral part of the whorls are solidly submerged within the callus and only the protoconch is free. Aperture very small, outer lip with 7-10 denticles which extend only for a short distance into the aperture, anterior of columella with 2-6 small denticles. White in colour, spire whorls with a single dark green subsutural band, body whorl with a narrow band at the suture, followed by a whitish band and a broad, dark green band towards the base; columellar shield white but frequently with an orange flush above the parietal wall; interior of aperture white, broadly banded with purple-brown. Operculum serrate at the margin.

TYPE LOCALITY: Burias I., Philippines.

HABITAT: in coral sand, intertidal.

Material examined: Samoa I.; Lifu, Loyalty I.; New Hebrides: Tuki Tuki Pt.; Port Havannah; Malapoa Pt., Vila Harbour.

Nassarius (Plicarcularia) graniferus (Kiener, 1834) (Figs. 15, 27 - 28)

1789. *Buccinum verrucosum* Bruguière, Encycl. Méth. vers 1: 279 (ref. Lister, pl. 972, fig. 27) [*nom. oblitum*].

1817. *Buccinum verrucosum* Bruguière, Dillwyn, Desc. cat. rec. shells 2: 605.

1825. *Buccinum verrucosum* Wood, Ind. Test. p. 107, pl. 22, fig. 45.

1834. *Buccinum graniferum* Kiener, Spéc. gén. icon. coq. viv. 9: 100, pl. 27, fig. 111.

1853. *Nassa granifera* Kiener, Reeve, Conch. Icon. 8: pl. 1, fig. 72.

1854. *Nassa obliqua* Hombron & Jaquinot, Voy. Pole Sud 5: 84, pl. 21, figs. 43, 44 (non *Buccinum obliquum* Kiener, 1841).

1856. *Buccinum verrucosum* Hanley in Wood, Ind. Test. p. 113, pl. 22, fig. 45 (with *B. graniferum* in synoymy).

1904. *Nassa perlata* "Meuschen", Hidalgo, Rev. R. Acad. Cienc. Madrid 1: 203 *(non binom.)*.

1957. *Nassarius graniferus* Kiener, Kaicher, Indo-Pacific sea shells pl. 7, fig. 4.

1964. *Arcularia (Plicarcularia) granulifera (sic)* (Kiener), Habe, Shells west. Pacific col. 2: 99, pl. 32, fig. 12.

Shell 14-23mm in length, sculptured with 2 spiral rows of pointed granules on the penultimate whorl and 4-5 rows on the body whorl; a spiral groove, which is paired on the penultimate whorl and at the body whorl suture, separates rows of nodules, intervening spaces containing macroscopic hairlines. Columellar callus inturned

and moulded to the shell and spreading almost to the nuclear whorls; the nodulose sculpture is visible underneath the callus shield above the parietal wall. Aperture lirate, anterior of columella either smooth or with 1-3 denticles. Cream, flesh to light fawn in colour, nodules whitish, columellar callus white, back of anterior canal bordered with yellow or orange, interior of aperture yellow. Operculum generally serrate at margin, but rare individuals are smooth at the margin.

TYPE LOCALITY: East Indies.

HABITAT: In coral and weedy sand, intertidal.

Material examined: Gambier I., Pacific; Rarotonga, Cook I.; Manava I., Fiji I.; Lifu, Loyalty I.; S.W. of Biak wharf, W. New Guinea; Direction I., Cocos-Keeling I.

Buccinum verrucosum Bruguière, is a prior but unused name for *Nassarius graniferus* (Kiener). Kiener's taxon has been in general use in the last 50 years and *Buccinum verrucosum* is considered a *nomen oblitum*.

Nassarius (Plicarcularia) globosus (Quoy & Gaimard, 1833) (Figs. 16 - 18, 22)

1833. *Buccinum globosum* Quoy & Gaimard, Voy. L'Astrolabe 2: 448, pl. 32, figs. 25-27.

1834. *Buccinum clathratum* Kiener, Spéc. gén. icon. coq. viv. 9: 101, pl. 27, fig. 108 *(nom. subst. pro B. globulosum (sic)* Quoy & Gaimard) [non *B. clathratum* Born, 1778].

1853. *Nassa globosa* Quoy & Gaimard, Reeve, Conch. Icon. 8: pl. 10, figs. 62a, b.

1957. *Nassarius globosus* Quoy & Gaimard, Kaicher, Indo-Pacific sea shells pl. 7, fig. 23.

1966. *Plicarcularia gibbosuloidea* Habe & Kosuge, Shells world col. 2: 60, pl. 22, figs. 5, 6 *(nom. nud.)*.

1966. *Plicarcularia globosa* (Quoy & Gaimard), Habe & Kosuge, Shells world col. 2: 60, pl. 22, figs. 10, 11.

1966. *Plicarcularia gibbosuloidea* Habe & Kosuge, Jap. J. Malac. 24: 317, 331, pl. 29, figs. 2, 3 (New Caledonia).

Shell 8-15mm in length, globose, sculptured with numerous, close-set and oblique axial ribs which number from 24-32 on the penultimate and from 18-34 on the body whorl; axial ribs occasionally completely absent on the dorsal side of the body whorl with the exception of a few crowded axials on the back of the outer lip. Dorsal hump either well developed or absent in some individuals. In the granose form of the species, finely incised spiral striae render axial ribs granulose. Aperture small, columellar callus spreading and orbicular, not quite reaching body whorl suture; outer lip with 5-10 denticles which extend as lirae into the aperture, anterior of columella with 2-4 small denticles. Variable in colour, white, fawn or tan, ornamented with a broad, light to dark brown band on the body whorl: some specimens are white, with a faint body whorl band. Aperture purple-brown, banded with white. Operculum serrate at the margin.

TYPE LOCALITY: Carteret Harbour, New Ireland.

HABITAT: In coral and weedy sand, intertidal.

Material examined: Oahu, Hawaiian I.; Tonga I.; Apia, Upolu, Samoa I.; Malua, Samoa I.; Naviti I., Yasawa group, Fiji I.; Manava I., Fiji I.; New Hebrides: Port

Havannah; Tuki Tuki Pt.; Malapoa Pt., Vila Harbour, all Efate I.; Tevuki, Kadavu, Fiji I.; Guadalcanal, Solomon I.; Lifu, Loyalty I.; Moreton Bay, Qld., Australia; N.E. Ambai, Japen I., W. New Guinea; N. Babelthuap, Palau I.; Philippines; Singapore.

Kiener's substitute name for *Buccinum globosum* was unnecessary since *Nassa globosa* Sowerby, 1828 (= *Demoulea abbreviata* Gmelin, 1791) does not preoccupy *Buccinum globosum* Quoy & Gaimard. Habe & Kosuge (1966) proposed *Plicarcularia gibbosuloidea* for the smooth, white and brown-banded form of *N.globosus*. This particular form is moderately common in Melanesian localities and there is a gradual integradation from the typical reticulated form to the smooth form in populations from Samoa, Fiji and the New Hebrides.

Nassarius (Plicarcularia) sordidus (A. Adams, 1852) (Figs. 26, 29)

1852. *Nassa sordida* A. Adams, Proc. Zool. Soc. Lond. p. 97.

1853. *Nassa sordida* A. Adams, Reeve, Conch. Icon. 8: pl. 15, fig. 96.

1969. *Nassarius (Chelenassa) elegantissimus* Shuto, Mem. Fac. Sci. Kyushu Univ., ser. D, Geol. 19: 142, pl. 13, figs. 1-10, 13, 14, 19-21, textfigs. 27, 28 (Panay I., Neogene of Philippines).

Shell 18-22mm in length, sculptured with numerous, slender axial ribs which number from 25-28 on the penultimate and from 28-32 on the body whorl; ribs continue on the body whorl in undiminishing strength towards the back of the outer lip. Finely incised spiral grooves override axial ribs and separate them into nodules. The centre of the dorsum lacks a hump or callus, and in some specimens an obsolete gibbosity is only faintly indicated. Columellar callus thick, truncated at the top and either short or barely overlapping body whorl suture; labial lip with 9-10 denticles which continue as lirae inside the aperture, lower half of columella with 4-5 small denticles. Base colour white, banded with a broad, brown band leaving a narrow white central line exposed; some specimens predominantly brown and paling towards sutures and either side of the centre of the dorsum. Columellar callus white or yellow, aperture purplish-brown, banded with white. Operculum serrated at the margin.

TYPE LOCALITY: Ilo Ilo, Panay I., Philippines.

HABITAT: In silty sand, intertidal.

Material examined: Passage west of Koror I., Palau I.; Bohol, Philippines.

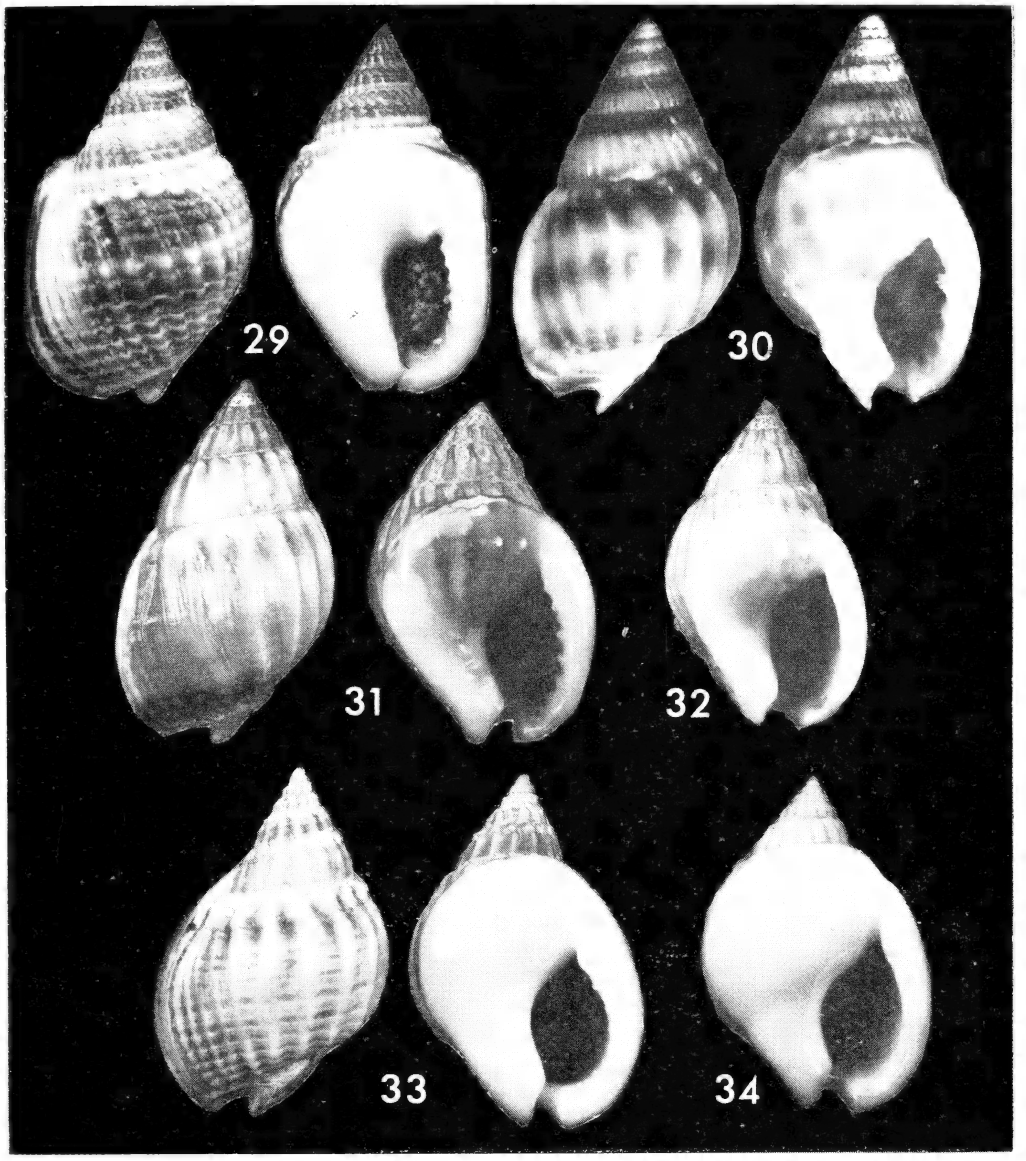
Nassarius (Plicarcularia) callosus (A. Adams, 1852) (Fig. 30)

1852. *Nassa callosa* A. Adams, Proc. Zool. Soc. Lond. p. 98.

1854. *Nassa callosa* A. Adams, Reeve, Conch. Icon. 8: pl. 28, figs. 185a, b.

1932. *Nassa delicata* A. Adams, Tomlin, Proc. Malac. Soc. Lond. 22: 42 (synonymised with *N. callosa*).

Shell 6-8mm in length, shining, sculptured with oblique axial ribs which number from 20-28 on the penultimate and from 14-20 on the body whorl; a shallow presutural groove separates axial ribs from a row of small sutural nodules. Interstices of axial ribs on the body whorl with finely incised spiral grooves, last 3-4 grooves becoming over-



Figs. 29-34. 29. *Nassarius (Plicarcularia) sordidus* (A. Adams). W. of Koror I., Palau I. 21.0mm. 30. *N. (P.) callosus* (A. Adams). N.W. of Black River, Mauritius; 7.8mm. 31-32. *N. (P.) burchardi* (Dunker). Clontarf, Sydney, Australia. 31. Denticulate outer lip; 13.0mm. 32. Smooth outer lip; 12.0mm. 33-34: *N. (P.) jonasii* (Dunker). 33. Shellharbour, N.S.W., Australia. Outer lip denticulate; 13.6mm. 34. Clontarf, Sydney, Australia. Outer lip smooth; 12.5mm.

riding spiral threads. Columellar callus spreading, orbicular and moderately thin, reaching the body whorl suture; columella with 1-7 small denticles anteriorly, outer lip with 5-7 denticles, back of outer lip thickened and varied. Shining, translucent-white to fawn in colour, spire whorls with a brown sutural band, body whorl with 3 brown bands; central band frequently more saturated in the interstices than upon the axial ribs. Callus white, interior of aperture white with brown spotted bands.

TYPE LOCALITY: Bais, Negros I., Philippines, 7 fathoms.

HABITAT: On a sand and weed substratum, sublittoral.

Material examined: N.W. of Black River, W. Mauritius, 16 metres.

Nassarius (Plicarcularia) burchardi (Dunker in Philippi, 1849) (Figs. 31 - 32, 56)

1849. *Buccinum burchardi* Dunker in Philippi, Abb. Beschr. Conch. 3: 69, pl. 2, fig. 14.

1936. *Parcanassa ellana* Iredale, Rec. Aust. Mus. 19: 322 (New South Wales).

1962. *Parcanassa burchardi* (Philippi), Macpherson & Gabriel, Mar. Moll. Victoria p. 195, fig. 232.

Shell 9-15mm in length, sculptured with slender but slightly swollen and often corrugated axial ribs which number from 10-17 on the penultimate and from 9-20 on the body whorl; axial ribs somewhat nodulose at sutures and becoming weak or obsolete on the dorsum towards the outer lip. Interstices smooth, but some individuals have 2 weak spirals on the penultimate whorl, and the lower half of the body whorl bears 3-7 spiral threads. Columellar callus orbicular and expanded, reaching the body whorl suture but thinner above the parietal wall; anterior of columella with 2-5 small denticles, edge of outer lip either smooth or with up to 9 denticles. These denticles, whenever present, are confined to the margin of the outer lip and the interior of the aperture is smooth. Light to dark brown in colour, penultimate whorl with a blackish-brown sutural band, body whorl with a sutural band and an additional brown band at the base; columellar callus flushed with yellowish-brown, interior of aperture white, yellow or brown, inside of siphonal canal usually violet.

TYPE LOCALITY: Adelaide, South Australia.

HABITAT: Intertidal and sublittoral.

Material examined: Port Adelaide River, S. Australia; Outer Harbour, Adelaide, S. Australia; North Harbour, Port Jackson, N.S.W.; Clontarf, Sydney Harbour, N.S.W.; Balmoral, Sydney, N.S.W.; La Perouse, N.S.W.; Moreton Bay, Queensland.

Nassarius (Plicarcularia) jonasii (Dunker, 1846) (Figs. 33, 34)

1846. *Buccinum jonasii* Dunker, Zeit. Malakozool. 3: 171.

1849. *Buccinum jonasi* Dunker, Philippi, Abb. Beschr. Conch. 3: 66, pl. 2, fig. 10.

1955. *Parcanassa jonasi* Dunker, Cotton, R. Soc. Sth. Aust. Malac. Sect. No. 7: fig. 7.

Species similar in size and sculpture to *N. burchardi* but differs in the following features: interstices of axial ribs prominently grooved, grooves extending along the entire length of the body whorl forming 4-6 clathrate cords at the base. Columellar callus thicker and more solid, orbicular, reaching, or only slightly extending past the body whorl suture; callus shield completely smooth on the columellar side, lacking the small denticles which are present in *N. burchardi*. Similarly to the latter, the margin of the outer lip either smooth or denticulate. Columellar callus white and not flushed with brown, area above the parietal wall not thinned as in *N. burchardi* but solid. Fawn to ash-grey rather than brown, interior of aperture brown.

TYPE LOCALITY: None.

HABITAT: Intertidal and sublittoral.

Material examined: Clontarf, Sydney Harbour; Gunnamatta; Balmoral, Sydney; Maroubra; Shellharbour, all New South Wales.

Cotton (1955) describes the aperture of *N.jonasii* as non-denticulate, but similarly to other Australian temperate water nassarids, the aperture is either smooth or denticulate.

Subgenus **Niotha** (H. & A. Adams, 1853)

Niotha H. & A. Adams, 1853, Gen. Rec. Moll. 1: 117. Type species by SD (Cossmann, 1901). *N. cumingi* A. Adams = *Nassa cumingii* A. Adams, 1852 = ? *N. stigmarius* A. Adams, 1852. Recent, Indo-Pacific.

1936. *Tavaniotha* Iredale, Rec. Aust. Mus. 19: 321, 337. Type species by OD *Nassa optata* Gould, 1860 = *N. nigella* Reeve, 1854. Recent, S.E. Australia (a *nomen nudum* — does not conform with requirements of art. 13 (i) of ICZN).

Shell moderately small, 15-30mm in length, sculptured with axial ribs, spiral striae, granules or spinose nodules; aperture ovate, columellar callus frequently thick but less expanding than in *Nassarius s. str.* or *Plicarcularia*, denticulate anteriorly. Outer lip denticulate, aperture smooth or lirate, siphonal canal short. Laterals of radula generally with simple cusps but occasionally inner cusps denticulate; accessory lateral plate usually present. Operculum serrate at the margin.

Nassarius (Niotha) variegatus (A. Adams, 1852) (Figs. 35 - 37)

1816. *Nassa clathrata* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 394, figs. 5a, b (non *Buccinum clathratum* Born, 1778).

1822. *Buccinum gemmulatum* Lamarck, Hist. Nat. anim. s. vert. 7: 271 (non Wood, 1818).

1825. *Buccinum clathratum* Wood, Ind. Test. p. 112, pl. 23, fig. 114 (E. Indies) [non Born, 1778].

1834. *Buccinum gemmulatum* Lamarck, Deshayes in Laborde & Linant, Voy. L'Arabie Petrée p. 66, figs. 35, 36 (Red Sea) [non Wood, 1818].

1834. *Buccinum gemmulatum* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 85, pl. 22, fig. 84 (non Wood, 1818).

1852. *Nassa verrucosa* A. Adams, Proc. Zool. Soc. Lond. p. 97 (Eastern Seas) [non *Buccinum verrucosum* Bruguière, 1789; nec Gmelin, 1791].

1852. *Nassa variegata* A. Adams, Proc. Zool. Soc. Lond. p. 97.

1853. *Nassa gemmulata* Lamarck, Reeve, Conch. Icon. 8: pl. 5, fig. 29.

1853. *Nassa verrucosa* A. Adams, Reeve, Conch. Icon. 8: pl. 6, fig. 36.

1853. *Nassa variegata* A. Adams, Reeve, Conch. Icon. 8: pl. 11, fig. 70.

1913. *Nassa (Niotha) gemmulata* var. *variegata* A. Adams, Schepman, Siboga-Exp. 49d: 328.

1929. *Niotha comtessei* Iredale, Aust. Zool. 5: 349, pl. 38, fig. 13 (Sydney Harb., Aust.).

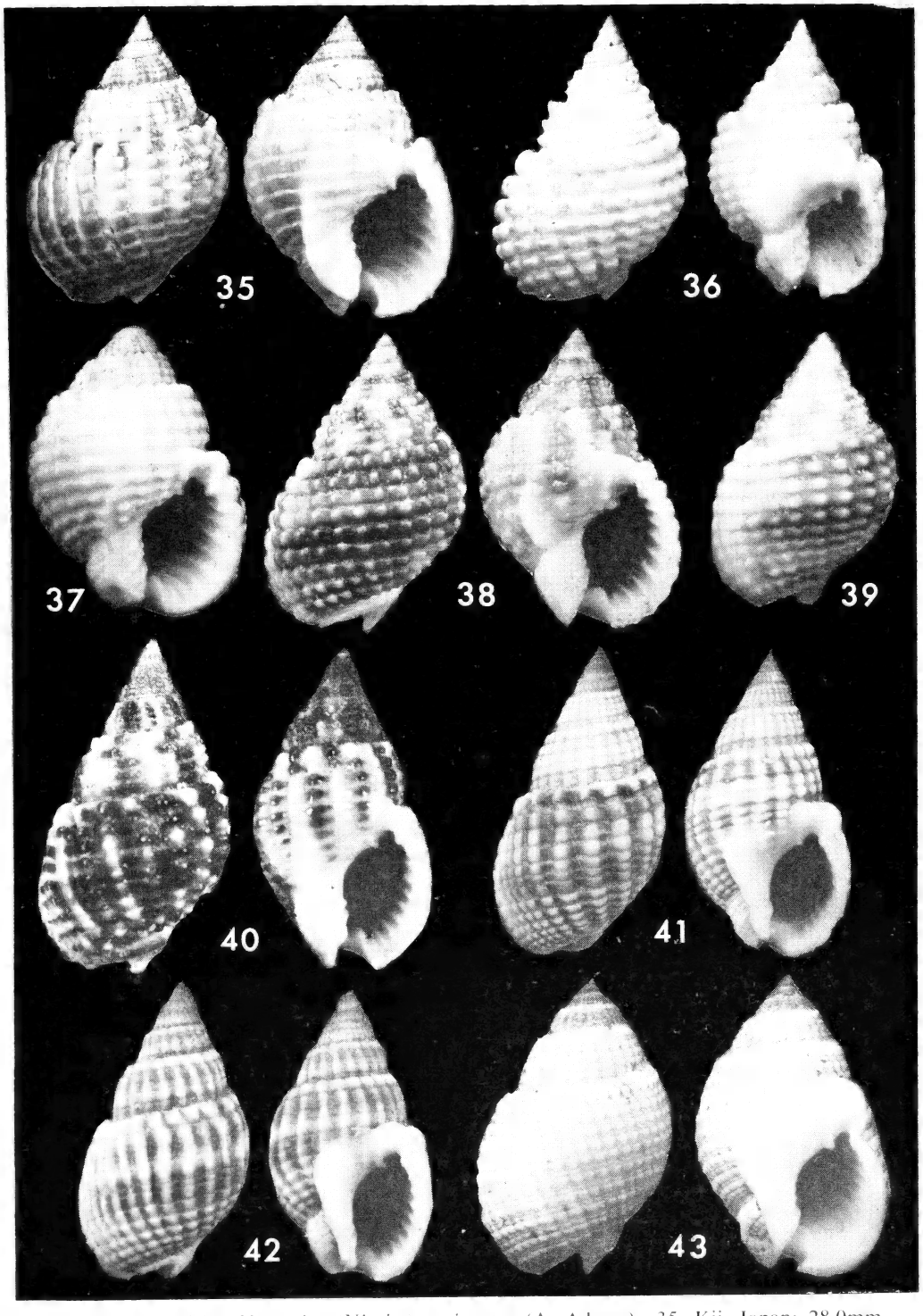
1932. *Nassa variegata* A. Adams, Tomlin, Proc. Malac. Soc. Lond. 22: 44.

1932. *Nassa verrucosa* A. Adams, Tomlin, Proc. Malac. Soc. Lond. 22: 44.

1945. *Nassarius (Niotha) gemmulatus* (Lamarck), Habe, Jap. J. Malac. 14: 195, fig. 16 (radula).

1957. *Nassarius gemmulatus* Gray, Kaicher, Indo-Pacific sea shells pl. 7, fig. 19.

1967. *Niotha clathrata* (Lamarck), Habe & Kosuge, Stand. Book Jap. shells col. 3: 76, pl. 29, fig. 38.



Figs. 35-43. 35-37. *Nassarius (Niotha) variegatus* (A. Adams). 35. Kii, Japan; 28.0mm. 36. Muscat, Gulf of Oman; 23.0mm. 37. Ballina, N.S.W., Australia; 26.0mm. 38, 39. *N. (N.) stigmarius* (A. Adams). 38. Teuma Bay, New Hebrides; 16.2mm. 39. Manava I., Fiji I.; 15.2mm. 40. *N. (N.) bifarius* (Baird). Teuma Bay, New Hebrides; 14.0mm. 41, 42. *N. (N.) livescens* (Philippi). 41. Kagashima, Japan; 21.0mm. 42. Sandakan, Borneo, Indonesia; 19.8mm. 43. *N. (N.) albescens albescens* (Dunker). Caboni beach, Fiji I.; 15.0mm.

Shell 23-30mm in length, inflated, sutures broad and flat or narrow and canaliculate, sculptured with regular granules which are arranged in 15-21 axial ribs on the body whorl and 17-29 ribs on the penultimate whorl; the granules form 4, rarely 5 spiral rows on the penultimate and 10, rarely 8 or 9 rows on the body whorl. Columellar callus extends on to the body whorl, and is thin next to the parietal wall, wrinkled and laminated anteriorly; columellar denticles irregular, numbering from 5-10, and generally appearing as small plicae or wrinkles. Aperture wide and striate within, outer lip with 8-10 denticles and occasionally short spines, siphonal notch very deep. Fawn to brown in colour, body whorl occasionally with 2 broad but very faint bands, columellar callus white or cream, interior of aperture white, banded with purplish-brown.

TYPE LOCALITY: Dalmaguete, Negros I., Philippines.

HABITAT: In coral and weedy sand, sometimes mud, intertidal and sublittoral.

Material examined: Balina, N.S.W., Australia; Horseshoe Bay, Magnetic I., Qld., Australia; Mikawa, Japan; Shioya Ki, Japan; Kinomotu, Kii, Japan; Tateyama, Japan; Minoshima, Wakayama-Ken, Japan; Gulf of Oman.

Nassa clathrata Lamarck, 1816, is undoubtedly congeneric with Born's Italian Pliocene *Buccinum clathratum,* and is a secondary homonym. Tomlin (1932a) considers *B.clathratum* Born to be a homonym of *B.clathratum* Linnaeus, and uses *Nassa subclathrata* d'Orbigny, 1852, for the fossil. Since Linnaeus did not describe a *Buccinum clathratum,* Born's specific name is available for the Italian Pliocene species. *Nassa verrucosa* A. Adams is a secondary homonym of *Buccinum verrucosum* Bruguière, 1789, which is a forgotten name for *Nassarius graniferus* (Kiener), and of *Buccinum verrucosum* Gmelin, 1791, a species very similar to *Nassarius stigmarius* (A. Adams). *Buccinum gemmulatum* Lamarck, 1822, is a primary homonym of *B.gemmulatum* Wood, 1818.

Nassarius (Niotha) stigmarius (A. Adams, 1852) (Figs. 38 - 39, 57)

1852. *Nassa stigmaria* A. Adams, Proc. Zool. Soc. Lond. p. 96.

1852. *Nassa retecosa* A. Adams, Proc. Zool. Soc. Lond. p. 97 (Albay, Luzon, Philippines).

1852. ? *Nassa cumingii* A. Adams, Proc. Zool. Soc. Lond. p. 98 (China).

1853. *Nassa retecosa* A. Adams, Reeve, Conch. Icon. 8: pl. 5, figs. 28a, b.

1853. ? *Nassa cumingii* A. Adams, Reeve, Conch. Icon. 8: pl. 5, figs. 30a, b.

1853. *Nassa stigmaria* A. Adams, Reeve, Conch. Icon. 8: pl. 7, figs. 42a, b.

1854. *Nassa densigranata* Reeve, Conch. Icon. 8: pl. 27, fig. 181 (Philippines)

1880. *Nassa adamsiana* Marrat, Var. shells gen. *Nassa* p. 99 (*nom subst. pro N. retecosa* A. Adams, 1852).

1925. ? *Nassa perligera* Thiele, Wiss. Erg. Deut. Tief.-Exp. "Valdivia" 17: 259, pl. 20, fig. 13 (Padang, Sumatra and Upolu, Samoa I.).

1934. *Nassa baguenai* Giner-Marí, J. Conchyl. 78: 30 (*nom. subst. pro N. reticosa (sic)* A. Adams, 1852).

1936. ? *Niotha hawleyi* Iredale, Rec. Aust. Mus. 19: 322, pl. 24, fig. 11 (Sydney Harb., Aust.).

1939. *Nassarius (Niotha) conoidalis* (Deshayes), Oostingh, Ing. Nederl.-Indie 5 (12): 183, pl. 16, figs. 286, 287 (non *Buccinum conoidale* Deshayes in Bélanger, 1832).

1961. *Niotha stigmaria* (A. Adams), Habe Col. Illust. shells Jap. 2: 64, pl. 32, fig. 13.

Smaller than *N.variegatus*, generally 14 - 18 mm in length, differing at first appearance in features of finer sculpture. The number of axial ribs and spiral rows of granules, however, do not differ from the number present in *N.variegatus*, but being smaller specimens, the axial ribs appear more closely set. The sutural ramp in *N.variegatus* is either broad and flat or deeply channelled, but in *N.stigmarius* the sutures lack the flat ramp or channel and are tightly pressed onto the succeeding whorl. The colour is cream to fawn, blotched with brown, last whorl with 2 brown bands. In all other respects, the two species are very similar. The operculum is serrate at the margin.

TYPE LOCALITY: Siquijor I., Philippines.

HABITAT: In weedy and muddy sand, to a depth of 25 fathoms (46 metres).

Material examined: Christmas I., Pacific, 22 metres; Manava I., Fiji I., intertidal; Teuma Bay, Efate I., New Hebrides, 37-46 metres; Horseshoe Bay, Magnetic I., Qld., Australia.

The large *Nassarius variegatus* has not been recorded from Fiji and the New Hebrides, but *N.stigmarius* is occasionally collected in that area. Further research is indicated as to the relationship and validity as biospecies of the two forms.

Nassarius (Niotha) bifarius (Baird, 1873) (Figs. 40, 58)

1873. *Nassa bifaria* Baird, Cruise "Curacao" p. 436, pl. 38, figs. 1, 2 (New Caledonia).

1879. *Nassa bifaria* Baird, E. A. Smith, Proc. Zool. Soc. Lond. p. 803, pl. 50, fig. 7.

Similar to *N. stigmarius*, 11-15mm in length, more slender and with a longer and more pointed spire. Sculptured with 15-23 axial ribs on the body whorl and 16-21 ribs on the penultimate whorl; axial ribs decussated into granules by 4-5 elevated and flattened spiral cords on the penultimate and 9-11 cords on the body whorl. Interstices of axial ribs with macroscopic hairlines, sutural nodules occasionally larger than remaining ones. Columellar callus extends on to the body whorl and appears only as a thin glazing above the parietal wall and as a laminated callus on the columellar side; outer lip with 9-12 denticles which extend only halfway into the aperture, and minute sharp denticles on the edge of the lip. Columella with 4-8 irregular plicae or denticles. Cream to fawn in colour, ornamented with irregular dark brown streaks, spots and bands, interior of aperture white, banded with purple-brown. Operculum serrate at the margin.

TYPE LOCALITY: New Caledonia.

HABITAT: In weedy and black sand, from 18 - 46 metres.

Material examined: Teuma Bay, Efate I., New Hebrides, 37 - 46 metres.

The species is very similar to *N.stigmarius* and may represent only a population variant from deeper water.

Nassarius (Niotha) livescens (Philippi, 1849) (Figs. 41 - 42, 61)

1849. *Buccinum livescens* Philippi, Zeit. Malakozool. 5: 135.

1882. *Nassa livescens* Philippi, Tryon, Man. Conch. 4: 54, pl. 16, fig. 304.

1906. *Nassa nevilliana* Preston, Proc. Malac. Soc. Lond. 7: 34, textfig. (Ceylon ?).

1945. *Nassarius (Niotha) livescens* (Philippi), Habe, Jap. J. Malac. 14: 195, fig. 17 (radula).

1967. *Niotha livescens* (Philippi), Habe & Kosuge, Stand. Book Jap. shells col. 3: 76, pl. 29, fig. 36.

Shell 17-23mm in length, sculptured with 14-24 slender axial ribs on the body whorl and 16-26 ribs on the penultimate whorl; finely incised, deep or moderately shallow spiral grooves cut axial ribs into granules and number from 4-6 on the penultimate and from 11-13 on the body whorl. A slightly broader presutural groove separates a row of sutural granules from the axial ribs. Columellar callus extending on to the body whorl without reaching body whorl suture, callus occasionally thin above parietal wall but thick and laminated on the columellar side. Columella with 3-10 denticles, outer lip with 10-13 denticles which continue as lirae only for a short distance into the aperture; anal canal prominent. Base colour white or creamy-white, ornamented with 2-3 broad, brown or greenish-brown bands on the body whorl, colouring often more saturated on the dorsal side of the body whorl; aperture white, banded with purple-brown, columellar callus and outer lip white. Operculum serrate at the margin.

TYPE LOCALITY: Manila, Philippines.

HABITAT: In weedy and coral sand, intertidal.

Material examined: Manava I., Fiji I.; Kakula I., New Hebrides; Kagoshima Bay, Japan; Togi, Noto, Japan; Sandakan, N. Borneo, Indonesia; Siglap, Singapore.

Specimens collected in Fiji and the New Hebrides are dwarf populations of *N.livescens,* and range in size from 10 - 15 mm. Some of these individuals are almost dark brown in colour, with small areas of white, others are banded and a few are uniformly creamy-white. Beach-worn specimen of *N.livescens* are occasionally confused with *N.albescens gemmuliferus,* but the latter species lacks the deeply incised spiral grooves and the lirate interior of the aperture.

Nassarius (Nietha) albescens albescens (Dunker, 1846) (Figs. 43 - 44, 59)

1846. *Buccinum albescens* Dunker, Zeit. Malakozool. 3: 170.

1849. *Buccinum albescens* Dunker, Philippi, Abb. Beschr. Conch. 3: 68, pl. 2, fig. 15.

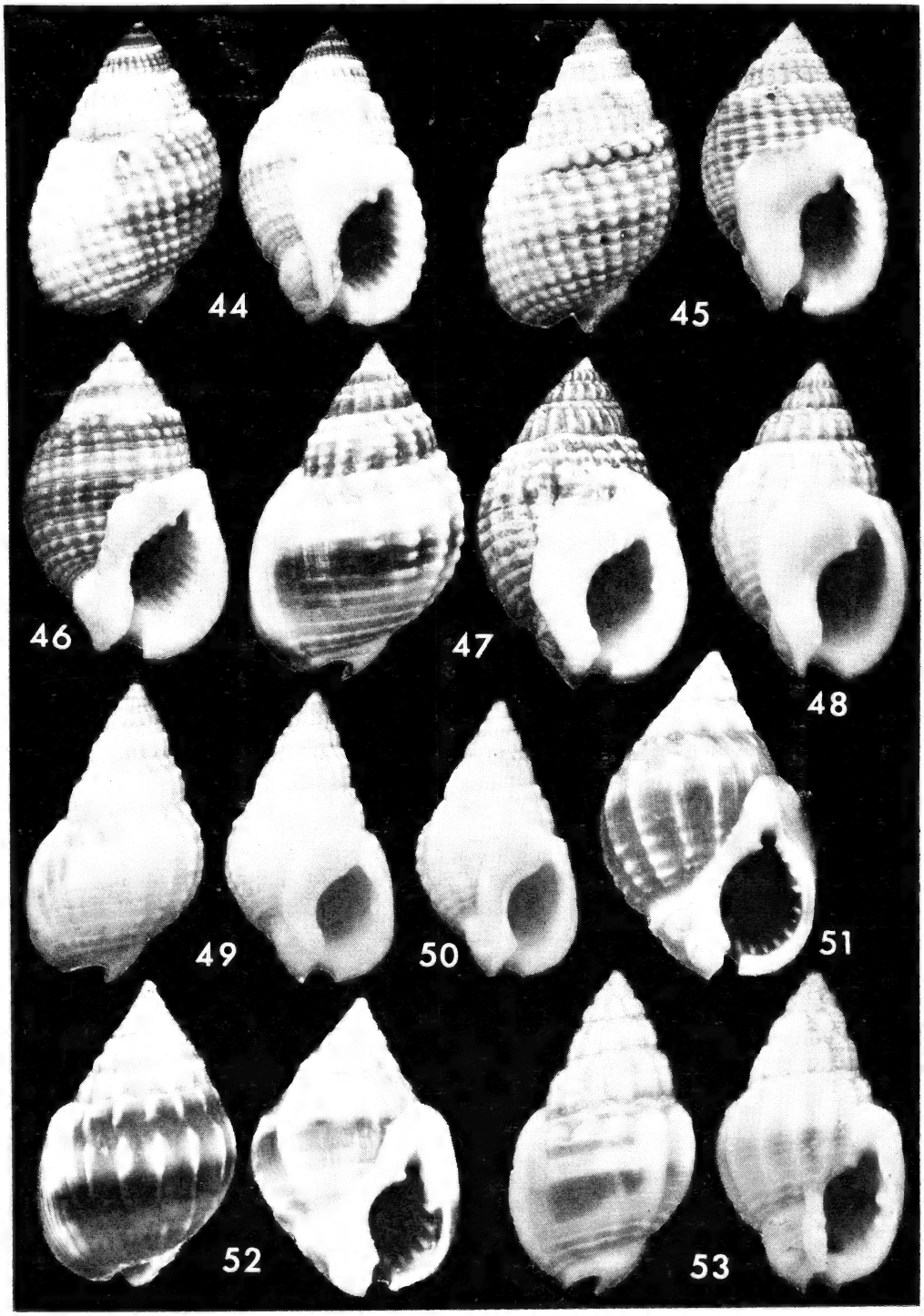
1853. *Nassa albescens* Dunker, Reeve, Conch. Icon. 8: pl. 15, fig. 100.

1854. *Nassa bicolor* Hombron & Jaquinot, Voy. Pole Sud 5: 84, pl. 21, figs. 41, 42 (non *Buccinum bicolor* Philippi, 1851 = *Nassarius).*

1877. *Nassa praecallosa* Marrat, Prop. new forms gen. *Nassa,* p. 11 (*fide* Tomlin, 1940).

1957. *Nassarius albescens* Dunker, Kaicher, Indo-Pacific sea shells pl. 7, fig. 12.

Shell 12-18mm in length, sculptured with numerous small granules which are arranged in the form of axial ribs, numbering from 20-30 on the penultimate and from 30-40 on the body whorl; at the sutures, 2 rows of granules are usually doubled up. Columellar callus thick and porcellaneous, squared on top and extending on to the body whorl without reaching the body whorl suture. Interior of aperture lirate, outer lip with 10-12 denticles, columella with 3-9 small plicae or short denticles. Cream, yellow or fawn in colour, occasionally faintly banded and sprinkled with brown, proto-



Figs. 44-53. 44. *Nassarius (Niotha) albescens albescens* (Dunker). S. Barnard I., Qld., Australia; 14.0mm. 45, 46. *N. (N.) albescens gemmuliferus* (A. Adams). 45. Kepwani, Zanzibar; 18.0mm. 46. Mauritius; 18.0mm. 47, 48. *N. (N.) pauperatus* (Lamarck). Port Lincoln, Sth. Australia. 47. Outer lip denticulate; 18.0mm. 48. Outer lip smooth; 17.2mm. 49, 50. *N. (N.) nigellus* (Reeve). Rosebud, Victoria, Australia. 49. Outer lip denticulate; 13.0mm. 50. Outer lip smooth; 12.4mm. 51, 52. *N. (N.) acuticostus* (Montrouzier). 51. Kakula I., New Hebrides; 19.0mm. 52. Tuki Tuki Pt., New Hebrides; 14.5mm. 53. *N. (N.) jacksonianus* (Quoy & Gaimard). Siglap, Singapore; 14.0mm.

conch golden-brown, 3-4 postnuclear whorls violet or purplish-brown; aperture white. Operculum serrate at the margin.

TYPE LOCALITY: West Indies = error!

HABITAT: In weedy and coral sand, intertidal.

Material examined: Toloa Pt., Upolu I., Samoa I.; Suva reef, Viti Levu, Fiji I.; Caboni beach, Fiji I.; New Hebrides: Malapoa Pt., Vila Harbour; Erakor lagoon; Port Havannah; Kakula I., Undine Bay, all Efate I.; Vailele beach, W. Samoa I.; Lifu, Loyalty I.; Australia: Long beach, Keppel Bay; Townsville; Horseshoe Bay, Magnetic I.; S. Barnard I.; Daydream I., Whitsunday group, all Queensland; Bourail, New Caledonia; Aoeri I., Geelvink Bay, W. New Guinea; Schonian Harbour, Peleliu, Palau I.

Dunker's (1846) locality indication of "West Indies" is either a slip of the pen for "East Indies" or simply an error; his description and subsequent illustration by Philippi, do not fit any known Caribbean species of *Nassarius*. The nominate species is confined to the Pacific Ocean.

Nassarius (Niotha) albescens gemmuliferus (A. Adams, 1852) (Figs. 45 - 46, 60)

1834. *Buccinum conoidale* Deshayes, Kiener, Spec. gen. icon. coq. viv. 9: 92, pl. 27, fig. 109 (? non Deshayes in Bélanger, 1832).

1852. *Nassa gemmulifera* A. Adams, Proc. Zool. Soc. Lond. p. 99.

1853. *Nassa isabellei* Reeve, Conch. Icon. 8: pl. 7, fig. 47 (non d'Orbigny, 1841).

1853. *Nassa gemmulifera* A. Adams, Reeve, Conch. Icon. 8: pl. 20, figs. 132a, b.

1877. *Nassa fenistrata* Marrat, Prop. new forms gen. Nassa p. 10 (*nom. subst. pro N. isabellei* Reeve, 1853).

1882. *Nassa fenestrata* Marrat, Tryon, Man. Conch. 4: 51, pl. 16, fig. 281 (emended spelling).

1891. *Nassa albescens* var. *fenestrata* Marrat, E. A. Smith, Proc. Zool. Soc. Lond. p. 408.

1930. *Nassarius (Niotha) fenestrata* var. *gastroi* Bisacchi, Ann. Mus. Civ. Stor. Nat. Genova 55: 49 (Aquaba, Red Sea).

The Indian Ocean subspecies differs from the nominate species in the following features: The sculpture is coarser in *gemmuliferus*, particularly on the body whorl where axial ribs number from 20 - 25. The protoconch is glassy-white or cream and the postnuclear whorls lack the violet or purplish-brown colouring of the Pacific *albescens*. The interior of the aperture is usually banded with purple-brown. In some individuals from East Africa, the main rows of gemmules on the body whorl have intermediate narrow fillets. The operculum is serrate at the margin.

TYPE LOCALITY: Burias I., Philippines, 6 fathoms.

HABITAT: In coral and muddy sand, intertidal.

Material examined: Tarut Bay, Persian Gulf; Raskamoni reef, Dar-es-Salaam, E. Africa; Kepwani, Uzi I., S.W. Zanzibar; Chawaka village, E. Zanzibar; Pt. Fievre, Nossi-Bé, N.W. Madagascar; Flic Flac, Mauritius; Natal, Sth. Africa.

Kiener (1834) considered *N.conoidalis* (Deshayes in Bélanger) to be a synonym of *N.marginulatus* (Lamarck), which is a Mediterranean species, but his figured specimen appears to be *albescens gemmuliferus*. Tryon (1882) synonymizes *N.conoidalis* with *N.gemmulatus* (Lamarck) (= *variegatus* A. Adams), while Hedley (1915) suggests *N.conoidalis* as an earlier name for *N.crematus* (Hinds). Oostingh's (1939) figure of *N.conoidalis* appears to be the species *N.stigmarius* (A. Adams). Only an examination of Deshayes' type, if still extant, can solve the nomenclatorial problem surrounding *N.conoidalis*.

Tomlin (1931), who examined the 2 syntypes of *Nassa gemmulifera* A. Adams, considers them to be small specimens of *Nassa fenestrata* Marrat.

Nassarius (Niotha) pauperatus (Lamarck, 1822) (Figs. 47 - 48, 55, 73)

1822. *Buccinum pauperatum* Lamarck, Hist. Nat. anim. s. vert. 7: 278.

1834. *Buccinum pauperatum* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 90, pl. 29, fig. 118 (Great Ocean and Tongatabu = error!).

1843. *Buccinum australe* Menke, Moll. Nov. Hollandiae p. 21 (New Holland) [non Gmelin, 1791].

1853. *Nassa pauperata* Lamarck, Reeve, Conch. Icon. 8: pl. 5, fig. 27.

1853. *Nassa lirella* Reeve, Conch. Icon. 8: pl. 14, fig. 95 (Hab: ?).

1932. *Nassa lirella* Reeve, Tomlin, Proc. Malac. Soc. Lond. 22: 96.

1962. *Parcanassa pauperata* (Lamarck), Macpherson & Gabriel, Mar. Moll. Victoria p. 193, fig. 231.

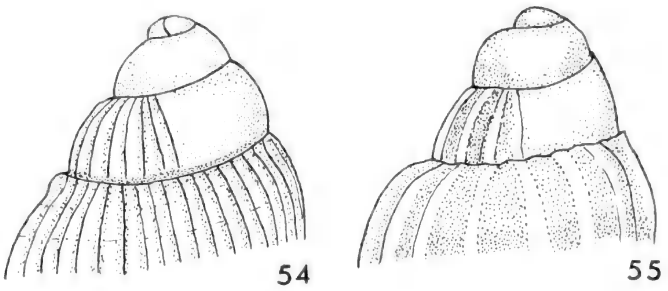
Shell moderately thin and inflated, 11-20mm in length, sculptured with coarse and granulose axial ribs and overriding spiral cords; sutural gemmules separated from the axial ribs by a shallow, smooth channel, ribs becoming obsolete on the dorsal side of the body whorl. Columellar callus orbicular and expanding partly on to the body whorl without reaching the body whorl suture; callus has a tendency to thin above the parietal wall. Outer lip backed by a varix, interior of lip either smooth or denticulate, columella with small, prominent or obsolete denticles. Variable in colour, generally creamy-white, ornamented with a broad brown band on the body whorl, some individuals uniformly creamy-white or brown; columellar callus and aperture white, sides of the siphonal canal frequently flushed with dark brown. Operculum generally serrate at margin, but sometimes smooth at the edges.

TYPE LOCALITY: None. (Australia - Menke, 1843).

HABITAT: In rock pools, among weed, intertidal.

Material examined: Albany, W. Australia; Tasmania; South Australia: Pt. Lincoln; N. of Stansbury, Yorke's Peninsula; Outer Harbour; Semaphore beach; Mulaton; Ceduna; Sultana Bay; Port Adelaide River; Arno Bay; Victoria: Port Fairy; Port Phillip Bay.

The syntypes of *Buccinum pauperatum* Lamarck (Fig. 73) are in the Museum d'Histoire Naturelle, Geneva No. 1102/13/1-5. The two illustrated syntypes measure 15.9 mm and 17.7 mm, and the label reads "Australie".



Figs. 54-55. Protoconchs. 54. *Nassarius (Niotha) nigellus* (Reeve). 55. *N. (N.) pauperatus* (Lamarck).

Nassarius (Niotha) nigellus (Reeve, 1854) (Figs. 49 - 50, 54, 64 - 66)

1846. *Buccinum semigranosum* Dunker, Zeit. Malakozool. 3: 170 (Hab: ?) [non Wood, 1828].

1849. *Buccinum semigranosum* Dunker, Philippi, Abb. Beschr. Conch. 3: 45, 68, pl. 1, figs. 9a-c; pl. 2, fig. 12 (non Wood, 1828).

1853. *Nassa semigranosa* Dunker, Reeve, Conch. Icon. 8: pl. 17, fig. 116.

1854. *Nassa nigella* Reeve, Conch. Icon. 8: pl. 26, figs. 173a, b.

1860. *Nassa optata* Gould, Proc. Bost. Soc. Nat. Hist. 7: 331.

1864. *Nassa munieriana* Crosse, J. Conchyl. 12: 345, pl. 13, fig. 6 (Gulf St. Vincent, S. Aust.).

1867. *Nassa (Alectrion) jacksoniana* Angas, Proc. Zool. Soc. Lond. p. 190 (non *Buccinum jacksonianum* Quoy & Gaimard, 1833).

1876. *Nassa tasmanica* Tenison-Woods, Proc. R. Soc. Tasmania p. 150 (N. & E. coast of Tasmania).

1915. *Arcularia semigranosa* Dunker, Hedley, Proc. Linn. Soc. N.S.W. 39: 735, pl. 83, fig. 78.

1915. *Arcularia tasmanica* Tenison-Woods, Hedley, Proc. Linn. Soc. N.S.W. 39: 737, pl. 84, fig. 81.

1932. *Nassa nigella* Reeve, Tomlin, Proc. Malac. Soc. Lond. 22: 96.

1932. *Nassa munieriana* Crosse, Tomlin, Proc. Malac. Soc. Lond. 22: 96.

1964. *Nassa optata* Gould, Johnson, Bull. U.S. Nat. Mus. 239: 119, pl. 16, fig. 4 (figd. lectotype).

Shell similar to *N. pauperatus* but smaller, 8-13mm in length, thinner and less bulbous at the body whorl; axial ribs on spire whorls more distinctly angulate on the presutural ramp, sculpture finer and more discreet. Outer lip either smooth or denticulate, columellar callus orbicular and not thinning in adult specimens. Protoconchs are slightly different, that of *N. nigellus* being convexly bulbous with first postnuclear whorls axially striate; protoconch of *N. pauperatus* is more button-shaped with first postnuclear whorls heavily ribbed (Figs. 54, 55). Uniformly cream in colour, some individuals light brown or occasionally banded with brown; aperture and columellar callus white or flushed with brown.

TYPE LOCALITY: New Zealand = error! (Sydney Harbour, Australia = *optata* Gould).

HABITAT: In rock pools, intertidal to a depth of 100 metres.

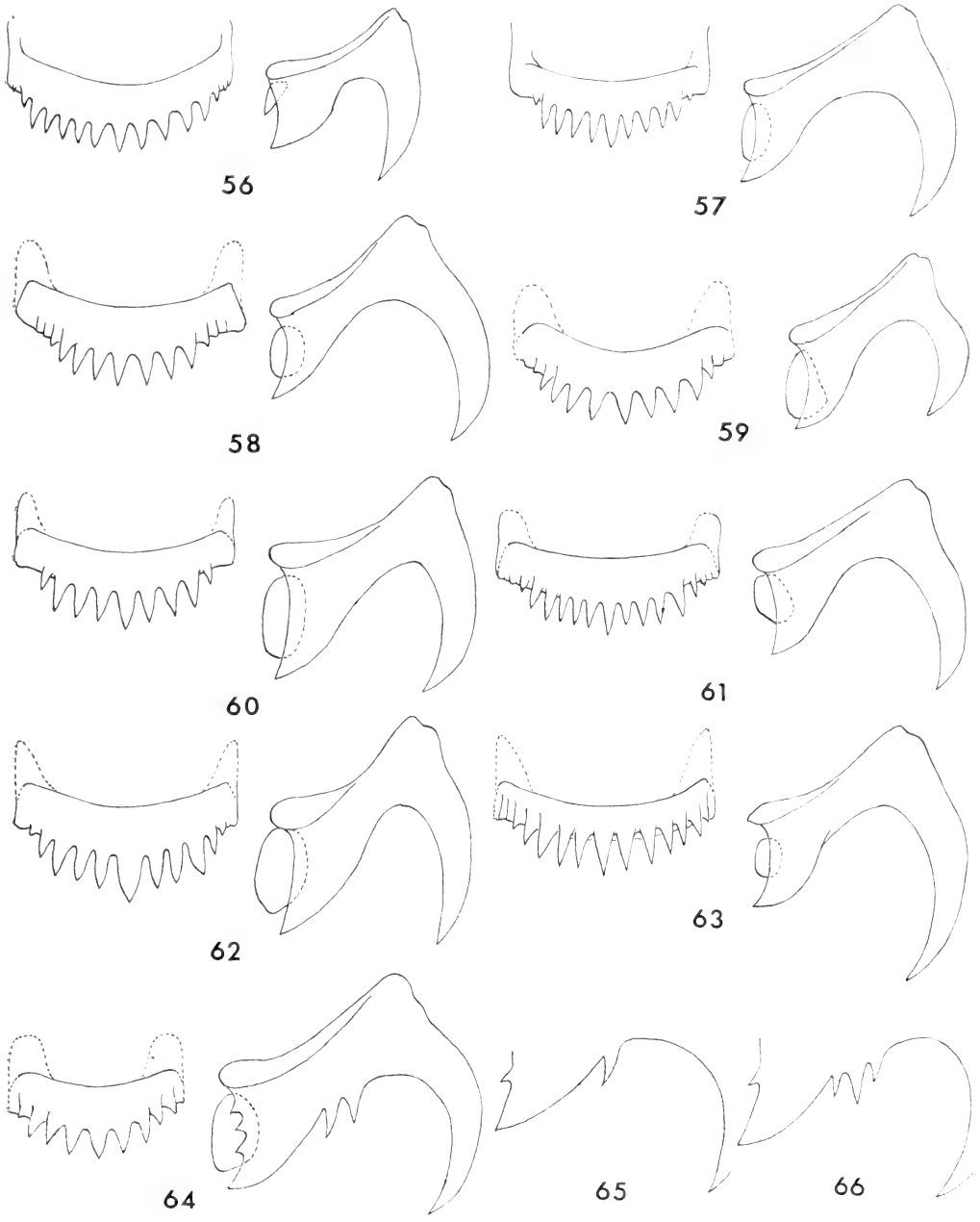
Material examined: Port Arthur, Tasmania; E. of Kangaroo I., Sth. Australia, 64 m; Rosebud, Victoria; Port Fairy, Victoria; New South Wales: Quarantine Bay, Port Jackson; Twofold Bay; Balmoral, Sydney; Shellharbour; Maroubra; off Coila; off Cronulla, 60 - 100 m.

Several writers have attempted to separate *N.nigellus* into species or subspecies on the basis of differences in apertural features, size and presence or absence of a varix on the body whorl. Examination of 181 specimens from 10 Australian localities has shown, that features of smooth or denticulate outer lip and the occasional presence of a varix are represented in almost all populations and not confined to a particular geographical area (Table 1). From these specimens examined, 17% of individuals had a dentate outer lip and only 4½% a varix on the body whorl. It is suspected that the majority of temperate water nassarids do not develop the heavily calloused outer lip of mature specimens and hence do not always develop denticles. The presence of a varix on the body whorl is probably due to an unusual rest-period during growth.

Table 1. Analysis of characters of *Nassarius nigellus* (Reeve) from Australia.

LOCALITY	No. of specimens	Specimens with a smooth outer lip	Specimens with a denticulate outer lip	Specimens with a varix
Off Coila, N.S.W.; 66-119 m	10	5	5	- -
Port Jackson, N.S.W.	5	5	—	—
Twofold Bay, N.S.W.	2	2	- -	—
Balmoral, Sydney, N.S.W.	24	16	8	—
Shellharbour, N.S.W.	88	85	3	7
Maroubra, N.S.W.	8	8	—	1
Rosebud, Victoria	10	5	5	—
Port Fairy, Victoria	4	—	4	—
Kangaroo I., S. Austr., 64 m	24	24	—	—
Port Arthur, Tasmania	6	—	6	—
TOTAL	181	150	31	8
PERCENTAGE		83	17	4.5

Iredale (1936) considered *Arcularia tasmanica* to be undoubtedly identical with *Nassa nigella* Reeve, but advocated the retention of *tasmanica* in a subspecific sense for Tasmanian shells because of their more pronounced sculpture. He further proposed the retention of *N.optata* Gould, for the New South Wales specimens which develop denticles on the outer lip and *N.munieriana* Crosse, for the Southern populations, which he differentiated as being larger and non-denticulate on the outer lip. *Buccinum semigranosum* Dunker, is the creamy-white, brown-banded form with an edentulous outer lip and *Nassa nigella* Reeve the brown-coloured form which is also edentulous. The type of *N.optata* Gould is the creamy-white form which also lacks denticles and *N.munieriana* Crosse the white, obsoletely banded form with a smooth outer lip and a varix on the body whorl. Hedley (1915) synonymized all these forms but accepted *tasmanica* as a good species because of the denticulate aperture. None of these described forms can be considered valid biospecies.



Figs. 56-66. Half-row of radulae. 56. *Nassarius (Plicarcularia) burchardi* (Dunker). Outer Harbour, Adelaide, Sth. Australia. 57. *N. (Niotha) stigmarius* (A. Adams). Manava I., Fiji I. 58. *N. (N.) bifarius* (Baird). Teuma Bay, New Hebrides. 59. *N. (N.) albescens albescens* (Dunker). Vila Harbour, New Hebrides. 60. *N. (N.) albescens gemmuliferus* (A. Adams). Kepwani, S.W. Zanzibar. 61. *N. (N.) livescens* (Philippi). Manava I., Fiji I. 62. *N. (N.) distortus* (A. Adams). Port Havannah, New Hebrides. 63. *N. (N.) acuticostus* (Montrouzier). Tuki Tuki Pt., New Hebrides. 64-66. *N. (N.) nigellus* (Reeve). Off Cronulla, N.S.W., Australia, 60-100 metres. 64. Half-row of radula. 65, 66. Laterals with 1 and 3 cusps from same radula.

Nassarius (Niotha) acuticostus (Montrouzier in Souverbie & Montrouzier, 1864) (Figs. 51 - 52, 63)

1849. *Buccinum crassum* Koch in Philippi, Abb. Beschr. Conch. 3: 43, pl. 1, fig. 4 (non Nyst, 1844; nec Catlow & Reeve, 1845).

1853. *Nassa crassa* Koch, Reeve, Conch. Icon. 8: pl. 7, figs. 46a, b; pl. 10, fig. 67.

1864. *Nassa acuticosta* Montrouzier in Souverbie & Montrouzier, J. Conchyl. 12: 273, pl. 10, fig. 8.

1934. *Nassa percrassa* Giner-Marí, J. Conchyl. 78: 24 *(nom. subst. pro N. crassa* Reeve, 1853, pl. 10, fig. 67).

1964. *Phrontis crassus* (Philippi), Habe, Shells west. Pac. col. 2: 99, pl. 32, fig. 11.

Shell broad, solid and crassate, 14-20mm in length, sculptured with wide-spaced and thin axial ribs which number from 11-17 on the penultimate and from 10-20 on the body whorl; axial ribs separated from the axially elongated sutural nodules by a shallow, concave depression; ribs becoming thin and crowded on the back of the outer lip, and in some individuals ribs become obsolete on the dorsal side of the body whorl. Postnuclear whorls with numerous, up to 15, crisp spiral striae which become obsolete on the last 2 whorls. Interstices on body whorl either smooth or with traces of rugose cords, and occasionally 4-5 rows of granules at the base. Columellar callus intrudes on to the body whorl only a short distance above the anal canal; back of outer lip thickened, interior with 6-12 denticles which extend as lirae for a short distance into the aperture. Columella with 5-14 irregular, small plicae. Cream or light green in colour, ornamented with 1-3 green or blackish-brown bands on the body whorl, sutural nodules occasionally flushed with light orange; interior of aperture white, banded with purple-brown.

TYPE LOCALITY: Art I., New Caledonia.

HABITAT: In coral sand, intertidal.

Material examined: Watson's I., Apia, Samoa I.; Tonga I.; Suva reef, Fiji I.; Kakula I., Undine Bay, New Hebrides; Tuki Tuki Pt., New Hebrides; Pango Pt., New Hebrides; Lifu, Loyalty I.; Nissan I., N. of Bougainville, Papua - New Guinea; Pt. Hedland, W. Australia; China Str., Papua - New Guinea; Oshima I., Ryuku I.; Chwaka, E. Zanzibar.

Buccinum crassum Koch in Philippi, is twice preoccupied and has been replaced with the available synonym *N.acuticostus*.

Nassarius (Niotha) jacksonianus (Quoy & Gaimard, 1833) (Fig. 53)

1833. *Buccinum jacksonianum* Quoy & Gaimard, Voy. L'Astrolabe 2: 452, pl. 32, figs. 28, 29.

1915. *Nassa jacksoniana* Quoy & Gaimard, Hedley, Proc. Linn. Soc. N.S.W. 39: 736.

Shell solid, 13-15mm in length, sculptured with prominently angulate and wide-spaced axial ribs which number from 12-13 on the penultimate and from 6-8 on the body whorl; axial ribs disappear on the dorsal side of the body whorl and are visible only as prominent nodules at the suture. Penultimate whorl with 4 strong and overriding spiral cords, body whorl with 12-15; on the last whorl, spiral cords tend to be weak or obsolete centrally. Columellar callus extending only for a short distance on to the

body whorl, strongly laminated on the columellar side; outer lip with 4-6 denticles which extend only for a short distance into the aperture, columella with 4-6 strong denticles anteriorly, varix on back of outer lip strong and broad. Cream in colour, ornamented with a narrow brown sutural band on the penultimate whorl and a broad and narrow band on the body whorl; in some individuals the bands have a bluish-green cast, and the aperture is white, banded with purple-brown.

TYPE LOCALITY: Port Jackson, Australia = error!

HABITAT: Unknown.

Material examined: Siglap, Singapore.

I have seen only 3 specimens of this contentious species which was erroneously described from Australia and has subsequently been included in the Australian fauna. Langdon (1875) correctly reported the species from Ceylon, and Hedley (1915) saw unnamed specimens of *N.jacksonianus* from Bombay in the British Museum. Quoy and Gaimard did not collect the species but were given a specimen by the Sydney botanist Fraser, and Hedley *(loc.cit.)* correctly suspects that the species did not originate from Australian shores.

Nassarius (Niotha) distortus (A. Adams, 1852) (Figs. 62, 67)

1834. *Buccinum monile* Kiener, Spéc. Gén. icon. coq. viv. 9: 68, pl. 11, fig. 40 (Purbeck & Weymouth = error! and coast of New Guinea) [non Linnaeus, 1771].

1852. *Nassa distorta* A. Adams, Proc. Zool. Soc. Lond. p. 105.

1853. *Nassa distorta* A. Adams, Reeve, Conch. Icon. 8: pl. 5, figs. 32a, b.

1853. *Nassa monile* Kiener, Reeve, Conch. Icon. 8: pl. 6, fig. 38.

1853. *Nassa lachrymosa* Reeve, Conch. Icon. 8: pl. 8, fig. 52 (Hab: ?).

1932. *Nassa distorta* A. Adams, Tomlin, Proc. Malac. Soc. Lond. 22: 42.

1957. *Nassarius monile* Kiener, Kaicher, Indo-Pacific sea shells pl. 7, fig. 21.

Shell solid, 16-28mm in length, sculptured with slender axial ribs which number from 13-16 on the penultimate and from 12-17 on the body whorl; axial ribs separated from sutural nodules by a shallow, concave trough, and on the body whorl ribs become wide-spaced and usually arcuate. Interstices completely smooth and coarse spiral cords develop only towards the base. Columellar callus thick and spreading in a circular sweep on to the body whorl, base of columella with 2-7 denticles. Outer lip with 11-17 lirae which extend only halfway into the aperture, edge of outer lip with small and spinose denticles. White to cream in colour, banded with green or greenish-brown, bands usually confined to the interstices of the axial ribs; columellar callus and apertural lirae white, smooth part of aperture banded with purple-brown. Operculum serrate at the margin, but in some individuals only 2 serrations at either side are present.

TYPE LOCALITY: None. (Coast of New Guinea – *monile* Kiener).

HABITAT: In weedy and coral sand, intertidal.

Material examined: Apia Harbour, Samoa I.; Vaoto, Vailele Bay, Upolu I., Samoa I.; Suva reef, Fiji .; Manava I., Fiji I.; Lifu, Loyalty I.; New Hebrides: Pango Pt.;

Meli I.; Port Havannah; Malapoa Pt., Vila Harbour, all Efate I.; Hundred I., Lucap, Philippines; Cebu, Cebu I., Philippines.

The well-known but preoccupied name *Nassarius monile* (Kiener) has been replaced with the next available *N.distortus* (A. Adams). According to Tomlin (1932a) the 3 syntypes of *N.distortus* are the not uncommon distorted form of *N.monile*.

Nassarius (Niotha) festivus (Powys, 1835) (Fig. 68)

1835. *Nassa festiva* Powys, Proc. Zool. Soc. Lond. p. 95.

1853. *Nassa festiva* Powys, Reeve, Conch. Icon. 8: pl. 18, fig. 17.

1967. *Hinia festiva* (Powys), Habe & Kosuge, Stand. Book Jap. shells col. 3: 76, pl. 29, fig. 33.

Shell 13-20mm in length, solid, sculptured with coarsely nodulose axial ribs which number from 9-14 on the penultimate and body whorl; the nodules on the axial ribs are connected by flat and often obsolete spiral cords which become more prominent towards the base of the shell. Columella calloused, generally laminated anteriorly, thin and glazed above the parietal wall; columella with a parietal denticle and 2-5 oblique plicae anteriorly. Outer lip thickened by a varix, interior with 5-7 prominent denticles. White to bluish-white in colour, transversely banded with reddish-brown, columellar callus white, aperture banded with purple-brown; some individuals are uniformly dark brown.

TYPE LOCALITY: Panama and St. Elena = error! (Japan - Tryon, 1882).

HABITAT: In muddy sand, intertidal and sublittoral.

Material examined: Takasago, Hyogoken, Japan; Tomioka, Tokyo Bay, Japan; Tsa Ise, Japan.

The original locality indication is incorrect and the species appears to be endemic to Japan.

Nassarius (Niotha) nodiferus (Powys, 1835) (Figs. 69, 70)

1835. *Nassa nodifera* Powys, Proc. Zool. Soc. Lond. p. 95.

1853. *Nassa nodifera* Powis, Reeve, Conch. Icon. 8: pl. 4, fig. 23.

1882. *Nassa hirta* Kiener, Tryon, Man. Conch. 4: 28, pl. 8, fig. 55 (non *Buccinum hirtum* Kiener, 1834).

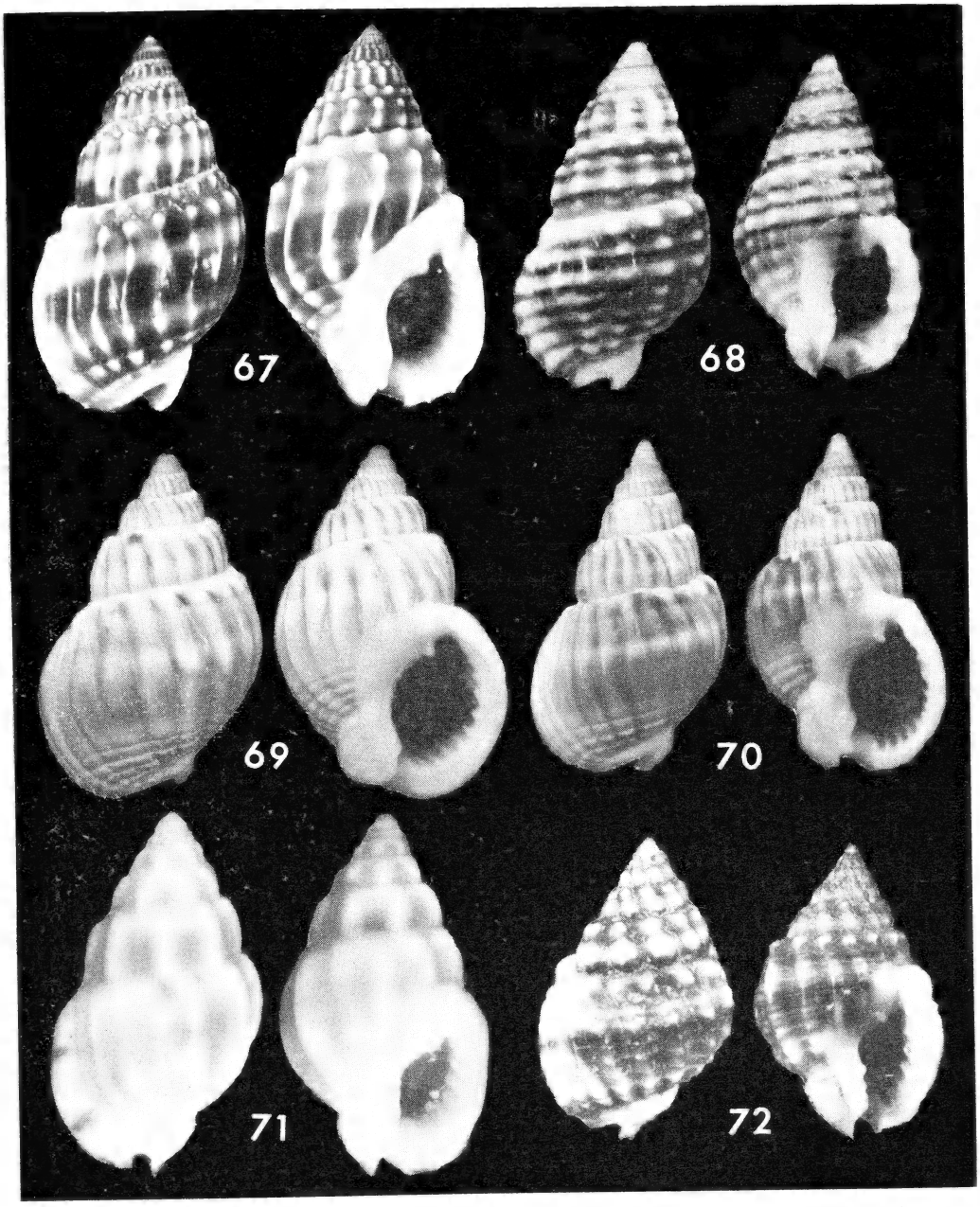
1901. *Nassa (Alectryon) nodifera* Powis, Melvill, Proc. Zool. Soc. Lond. p. 411 (Bombay).

1911. *Nassa nodifera* Powis, Schepman, Siboga-Exp. 49d: 315 (Indonesia & Singapore).

1934. *Nassa nodifera* Powis, Giner-Marí, J. Conchyl. 78-42.

Shell 20-30mm in length, whorls nearly convex, sculptured with coarse axial ribs which number from 13-18 on the penultimate and from 16-22 on the body whorl; axial ribs weakly constricted and subnodulose at sutures, interstices smooth, lower half of body whorl with spiral cords. Columella calloused and partly spreading on to the body whorl, anterior with 6-13 irregular denticles or short plicae; outer lip with 10-11 short plications, back of lip thickened by doubled up axial ribs. Greenish-grey or greyish-

brown in colour, occasionally darker in interstices at the sutures, ornamented with a pale and narrow spiral band; siphonal fasciole, columella and edge of outer lip white, aperture dark purple-brown, narrowly banded with white.



Figs. 67-72. 67. *Nassarius (Niotha) distortus* (A. Adams). Efate I., New Hebrides; 23.5mm. 68. *N. (N.) festivus* (Powys). Takasago, Hyogoka, Japan; 15.0mm. 69, 70. *N. (N.) nodiferus* (Powys). Hong Kong. 69. Broad form; 25.0mm. 70. Slender form; 28.4mm. 71. *N. (N.) ecstilbus* (Melvill & Standen). Tuki Tuki Pt., New Hebrides; 7.0mm 72. *Nassarius (Niotha)* sp. Malolo Barrier reef, Fiji I.; 13.0mm.

TYPE LOCALITY: Gallapagos and Panama, 6 - 10 fathoms = error!

HABITAT: Unknown.

Material examined: Hongkong.

The species has been confused with *N.hirtus* (Kierner) by Tryon (1882), a species which appears to be endemic to the Hawaiian chain, has a smooth columella and belongs to the subgenus *Alectrion*. Originally described from the Galapagos I. and Panama, the species has not been recognized as a member of the West American fauna, but has been reported by several authors from the Philippines, Singapore, Indonesia and Bombay (see Giner-Marí, 1934).

The similar species *N.hirtus* (Kiener) differs from *N.nodiferus* in being less solid and more slender, with more numerous and more slender axial ribs, prominently crenulate sutures, smaller columellar callus and smooth columella.

Nassarius (Niotha) ecstilbus (Melvill & Standen, 1896) (Fig. 71)

1896. *Nassa (Telasco) ecstilbus* Melvill & Standen, J. Conch. 8: 274, pl. 9, fig. 4.

Shell 6-10mm in length, shining, whorls convex, sculptured with coarse and widely spaced axial ribs which number from 10-12 on the body whorl and from 8-11 on the penultimate whorl; interstices only moderately broad and almost smooth on the spire whorls apart from a few presutural striae, but prominently striate on the dorsal side of the body whorl. Columellar callus prominent, partly overlapping on to the body whorl, columella with 2-6 very small and short plicae or denticles anteriorly; outer lip thick and backed by a varix, interior with 7-12 short denticles. White or creamy-white in colour, ornamented with a single, interrupted, orange-brown band on the spire whorls and 2 such bands on the body whorl; the narrow brown bands are almost obsolete in the interstices but more saturated upon the ribs, and also appear as two streaks on the outer lip varix. Most specimens have an orange-brown blotch on the dorsal side of the body whorl near the suture; columella and aperture white.

TYPE LOCALITY: Lifu, Loyalty Islands.

HABITAT: In clean coral sand, intertidal and sublittoral.

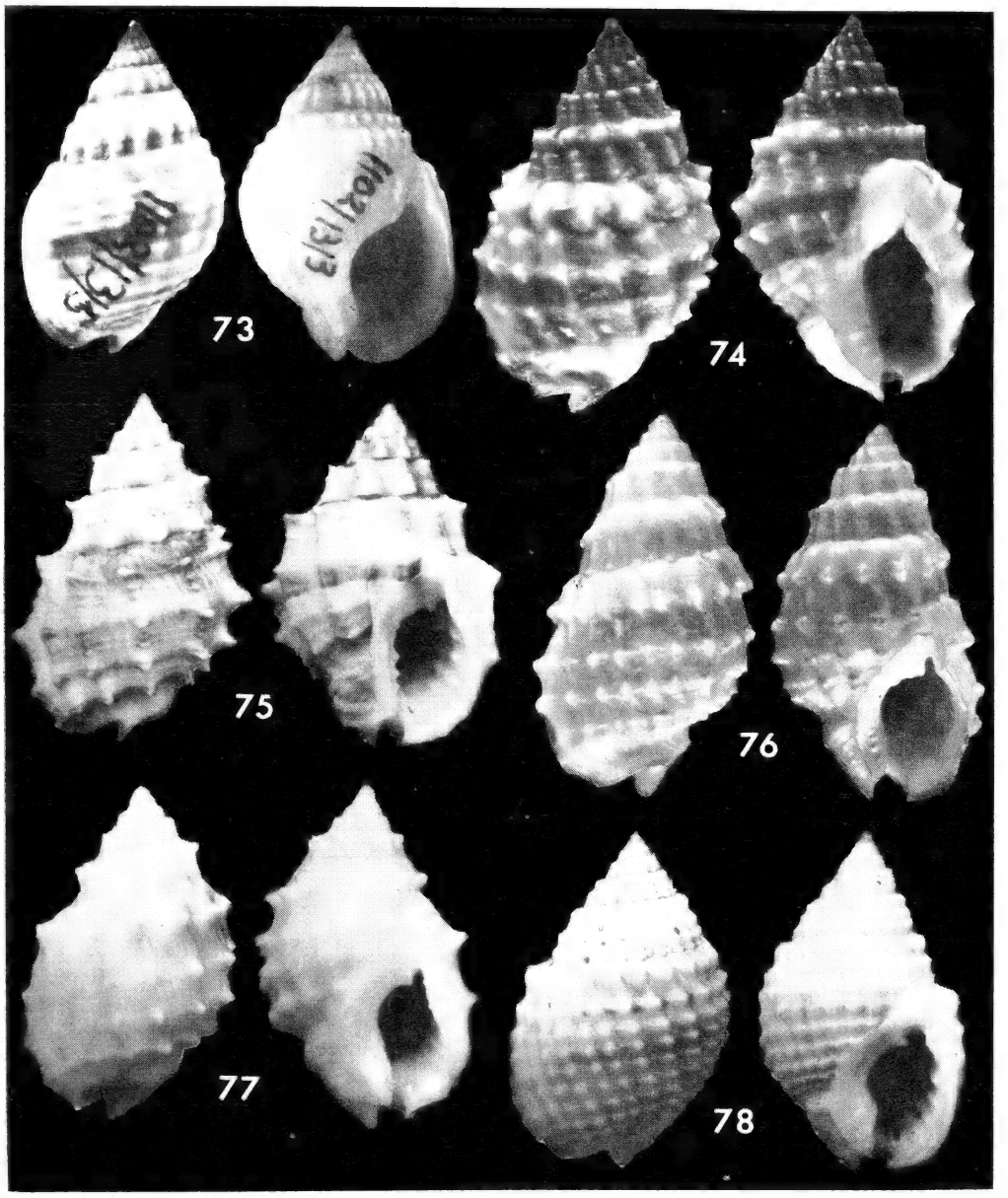
Material examined: Yanuca I., S.W. Viti Levu, Fiji, I., 5 m; Lifu, Loyalty I.; Tuki Tuki Pt., Efate I., New Hebrides.

Nassarius (Niotha) quadrasi (Hidalgo, 1904) (Figs. 74 - 75, 80, 87, 90 - 91)

1853. *Nassa gruneri* Reeve, Conch. Icon. 8: pl. 12, fig. 75 (non *Buccinum gruneri* Dunker, 1846).

1904. *Nassa quadrasi* Hidalgo, Rev. R. Acad. Cienc. Madrid 1 (3): 204 (ref. Reeve, 1853, fig. 75).

Shell 10-16mm in length, sculptured with angulate axial ribs which number from 8-10 on the penultimate and from 9-15 on the body whorl; overriding cords produce 2 rows of primary spines upon the axial ribs on the penultimate whorl and 4 rows on the body whorl. Interstices with 2-4 intermediate spiral threads which produce smaller



Figs. 73-78. 73. *Nassarius (Niotha) pauperatus* (Lamarck). Syntypes Mus. d'Hist. Nat. Geneva, No. 1102/13/5, 15.9mm and No. 1102/13/3, 17.7mm. 74, 75. *N. (N.) quadrasi* (Hidalgo). 74. Figured type of *Nassa gruneri* Reeve (= type of *quadrasi*), B.M.N.H. No. 197132, 15.1mm. 75. Manava I., Fiji I.; 14.5mm. 76, 77. *N. (N.) echinatus* (A. Adams). 76. Lectotype B.M.N.H. No. 1971131; 14.0mm. 77. Port Havannah, New Hebrides; 12.7mm. 78. *N. (N.) gruneri* (Dunker). Donsol, Luzon, Philippines; 16.5mm.

and less spinose nodules between the main spines. Aperture elongate, columella calloused but not expanding and laminated on the columellar side; outer lip with 6-10 denticles which extend only halfway into the aperture, base of columella with 3-4 main denticles and sometimes an additional 2-4 very small denticles posteriorly. White, cream

or light yellow in colour, occasionally flecked or banded with rusty-brown, columella and aperture white or cream, columella frequently flushed with yellow. Operculum serrated at the margin, but in some specimens the serrations are almost obsolete.

TYPE LOCALITY: Bohol and Cebu Islds., Philippines.

HABITAT: In coral sand, from the intertidal zone to a depth of 22 metres.

Material examined: Pilot Pt., Apia, Samoa I.; lagoon off Fuailalo, Upolu I., Samoa I., 4 - 6 m; Suva reef, Fiji I.; Manava I., Fiji I.; New Hebrides: Port Havannah; Kakula I., Undine Bay; Malapoa Pt., Vila harbour; Tuki Tuki Pt., all Efate I.

For further discussions see under *Nassarius echinatus* (A. Adams).

Nassarius (Niotha) echinatus (A. Adams, 1852) (Figs. 76-77, 79, 88, 92)

1852. *Nassa echinata* A. Adams, Proc. Zool. Soc. Lond. p. 101.

1853. *Nassa echinata* A. Adams, Reeve, Conch. Icon. 8: pl. 20, fig. 131.

1879. *Nassa echinata* A. Adams, E. A. Smith, Proc. Zool. Soc. Lond. 1878: 810, pl. 50, fig. 9 (Andaman I.).

1886. ? *Nassa echinata* A. Adams, Watson, Rep. Voy. H.M.S. Challenger 15: 184 (Levuka, Fiji I.).

1904. *Nassa quadrasi* var. *alba* Hidalgo, Rev. R. Acad. Cienc. Madrid 1 (3): 204 (ref. E. A. Smith, 1879, pl. 50, fig. 9 [non *N. alba* Say, 1826].

1939. ? *Nassarius echinatus* (A. Adams), Peile, Proc. Malac. Soc. Lond. 23: 276, fig. 46 (radula).

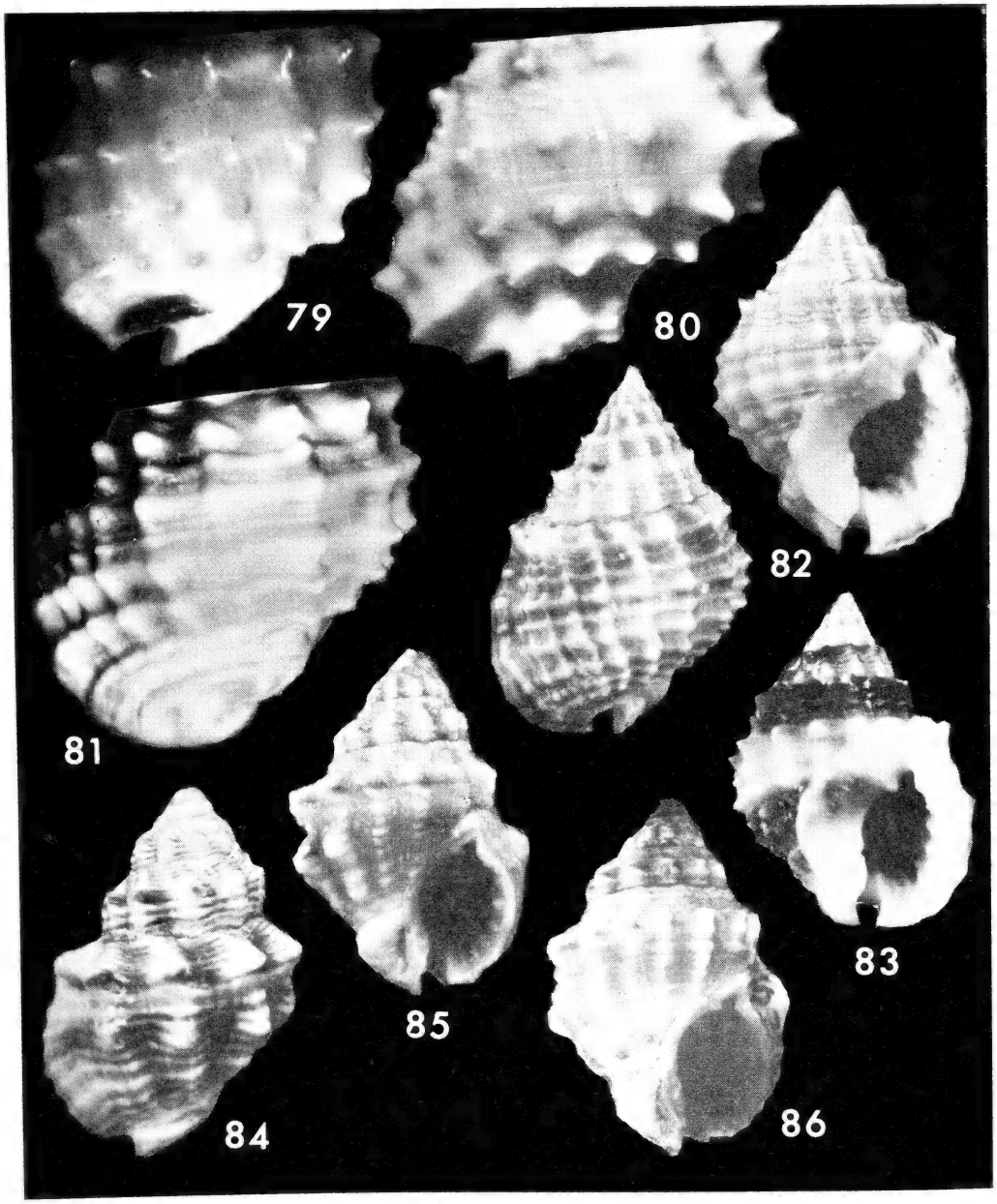
Shell small, 11-14mm in length, similar to *N. quadrasi* but differs in the following features: the surface is shining and not dull and the spines are more discreet and noduled at the tips; the body whorl usually has 4 spiral rows of spines but occasionally a fifth row merges with the fourth row anteriorly. Axial ribs less coarse than in *N. quadrasi,* and interstices completely smooth apart from macroscopic longitudinal striae; spiral cords only faintly indicated on the body whorl where they are confined to the walls of the axial ribs without intruding into interstices. Laminated anterior of columella filled with callus and recurved towards the aperture which is smaller than in *N. quadrasi.* White in colour, dorsal side frequently stained with orange-brown, back of siphonal canal with a horizontally oriented dark brown stain.

TYPE LOCALITY: Galeo, Mindoro I., Philippines.

HABITAT: In coral sand, intertidal.

Material examined: Port Havannah, Efate I., New Hebrides.

The species is frequently confused with *Nassarius quadrasi* and sometimes with *Hebra horrida* (Dunker), but the differences in sculpture (Figs. 79 - 81) and apertural features (Figs. 87 - 89) are sufficiently prominent to be considered separate species. *N.quadrasi* and *N.echinatus* are sympatric at Port Havannah, New Hebrides, without intergrades having been encountered.



Figs. 79-86. 79-81. Sculptural detail of body whorl. 79. *Nassarius (Niotha) echinatus* (A. Adams). 80. *N. (N.) quadrasi* (Hidalgo). 81. *Hebra horrida* (Dunker). 82, 83. *H. horrida* (Dunker). 82. Manava I., Fiji I.; 12.8mm. 83. Tuki Tuki Pt., New Hebrides; 13.0mm. 84-86. *H. subspinosa* (Lamarck). 84. Cape Santiago, Luzon, Philippines; 14.5mm 85. Bushmens Bay, Malekula I., New Hebrides; 13.0mm. 86. Syntype Mus. d'Hist. Nat. Geneva No. 1102/6/2; 14.0mm.

Smith (1879) described *N.echinatus* from the Andaman slands, and commented on the dark brown staining of the anterior canal, a feature omitted in the original description but present in all live-taken specimens of *echinatus*. Two syn-

types of *N.echinatus* (A. Adams) are in the British Museum (Nat. Hist.) No. 197131, and the illustrated specimen (Fig. 76), length 14.0 mm, is designated as the lectotype of *Nassa echinata* A. Adams, 1852; the dark brown stain on the back of the siphonal canal is only faintly visible on the worn and faded lectotype.

The holotype of *Nassa quadrasi* Hidalgo, which is the specimen figured by Reeve (1853, pl. 12, fig. 75) under the name *Buccinum gruneri* (non Dunker, 1846), is in the Brit. Mus. (Nat.Hist.) No. 197132, length 15.1 mm (Fig. 74).

Nassarius (Niotha) gruneri (Dunker, 1846) (Fig. 78)

1846. *Buccinum gruneri* Dunker, Zeit. Malakozool. 3: 171.

1849. *Buccinum gruneri* Dunker, Philippi, Abb. Beschr. Conch. 3: 63, pl. 2, fig. 2.

1850. *Nassa acinosa* Gould, Proc. Bost. Soc. Nat. Hist. 3: 154 (Hab: ?).

1852. *Nassa acinosa* Gould, U.S. Expl. Exp. 12: 261, pl. 19, figs. 329a, b.

1852. *Nassa hispida* A. Adams, Proc. Zool. Soc. Lond. p. 101 (Loon, Bohol I., Philippines).

1853. *Nassa hispida* A. Adams, Reeve, Conch. Icon. 8: pl. 6, figs. 37a, b.

Superficially similar to *Hebra horrida* (Dunker), but slightly larger, 15-18mm in length, more inflated, aperture less crassate and wider, sculptured with numerous and regular, small, pointed but non-spinose nodules which are arranged in 3-4 spiral rows on the penultimate and 8-10 rows on the body whorl. Axial ribs numerous, thin and close-set, numbering from 19-23 on the last two whorls. Columellar callus almost as large as in *Hebra horrida*, columella, although finely plicate, lacks the numerous wrinkles of *H. horrida;* columellar denticles number from 4-8 and extend only a short distance into the aperture, deep interior being smooth. Cream in colour, last whorl with 1-2 faint, bluish-green bands, columella and aperture cream, aperture banded with purple-brown.

TYPE LOCALITY: Philippines.

HABITAT: Unknown.

Material examined: Donsol, Luzon I., Philippines.

A radula was not available for examination and the assignment of this species to the subgenus *Niotha* is only tentative. The numerous, close-set and thin axial ribs and regular arrangement of nodules, separate this species from *Nassarius echinatus* and *Hebra horrida*.

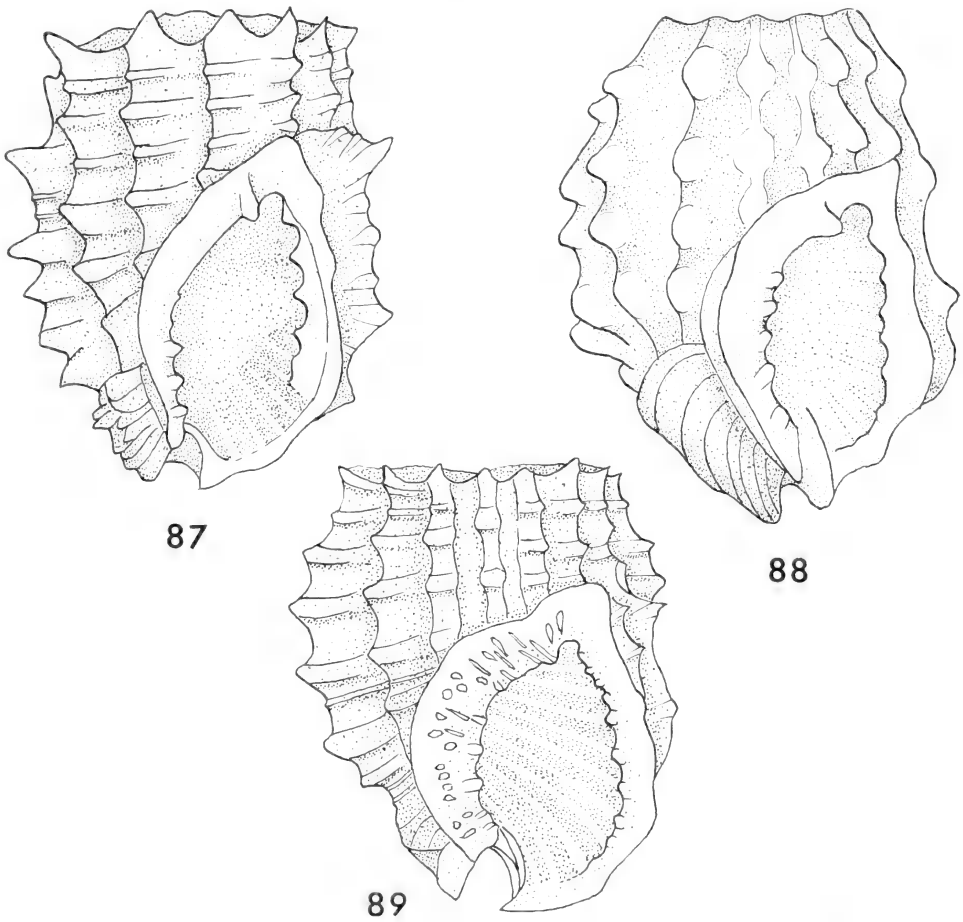
Nassarius (Niotha) sp. (Figs. 72, 93)

Shell 10-14mm in length, solid and squat, sculptured with broad, coarse nodulose and frequently oblique axial ribs, and a row of prominent nodules at the sutures; interstices carry spiral grooves which give rise to broad and flat and occasionally rope-like cords which override the ribs. Aperture narrow, outer lip thickened and varied on the back, interior with coarse denticles which continue as lirae halfway into the aperture; columella calloused and partly overlapping on to the body whorl, similarly as in *H. horrida*, and prominently denticulate anteriorly, siphonal fasciole calloused and recurved.

HABITAT: In coral and muddy sand, intertidal.

Material examined: Manava I., Fiji I.; Malolo Barrier reef, Mamanuca group, Fiji I.

The species has a superficial resemblance to *Hebra horrida* but the radula (Fig. 93) is of the *Nassarius* type. The identity of the species may be established when the type specimens of Nassariidae are examined.



Figs. 87-89. Apertural features. 87. *Nassarius (Niotha) quadrasi* (Hidalgo). 88. *N. (N.) echinatus* (A. Adams). 89. *Hebra horrida* (Dunker).

Subgenus **Telasco** H. & A. Adams, 1853

Telasco H. & A. Adams, 1853, Gen. Rec. Moll. 1: 119. Type species by SD (Oostingh, 1939) *Nassa variabilis* (Phil.) = *Buccinum variabile* Philippi, 1836 = *B. costulatum* Renier, 1804. Recent, Mediterranean & E. Atlantic.

1936. *Tarazeuxis* Iredale, Rec. Aust. Mus. 19: 322. Type species by OD *Nassa mucronata* A. Adams, 1852 = *N. gaudiosa* Hinds, 1844. Recent, Indo-Pacific. *(nom. nud.).*

Species of the subgenus *Telasco* are intermediate in shell-characters between *Niotha* and *Zeuxis*. The sculpture is less prominent, columellar callus less expanded and calloused than in *Niotha*, and the columella is not denticulate along the entire length as in *Zeuxis*. The laterals of the radula have 2 simple cusps and an accessory lateral plate is present.

Cossmann (1901) designated *Buccinum costulatum* Brocchi, 1814, a European Pliocene fossil as the type of *Telasco*, while Wenz (1943) cites *Buccinum cuvieri* Payraudeau, 1826, as the type, and equals it to *B.ferussaci* Payraudeau, 1826. Glibert (1963) follows Wenz, and Nordsieck (1968) lists *B.costulatum* Renier, 1804, as the type of *Telasco*, and considers it a prior name to *Buccinum cuvieri* Payraudeau. None of these species were among the originally included species, and the type designations are invalid. The first valid type designation the writer was able to trace, is the one by Oostingh (1939).

Tarazeuxis Iredale, 1936, is considered to be a *nomen nudum*. Iredale's (1936) statement when referring to *Nassa mucronata:* "It has been placed under *Zeuxis* but it does not correlate with *taenia* Gmelin, the type of *Zeuxis*", could hardly be construed to be a statement purporting to give characters differentiating the taxon, as required under the provisions of art.13(a)(i) of the Code of ICZN.

Nassarius (Telasco) gaudiosus (Hinds, 1844) (Figs. 97, 100 - 104)

1844. *Nassa gaudiosa* Hinds, Zool. Voy. "Sulphur" p. 36, pl. 9, figs. 16, 17.

1846. *Buccinum pictum* Dunker, Zeit. Malakozool. 3: 172 (? East Indies) [non Fleming, 1828].

1847. *Buccinum reeveanum* Dunker, Zeit. Malakozool. 4: 62. (? East Indies).

1849. *Buccinum pictum* Dunker, Philippi, Abb. Beschr. Conch. 3: 65, pl. 2, fig. 6 (non Fleming, 1828).

1849. *Buccinum reeveanum* Dunker, Philippi, Abb. Beschr. Conch. 3: 64, pl. 2, fig. 3.

1852. *Nassa filosa* "Gray MS", A. Adams, Proc. Zool. Soc. Lond. (publ. in synonymy of *N. reeveana* Dunker).

1852. *Nassa mucronata* A. Adams, Proc. Zool. Soc. Lond. p. 105 (Dumaguete, Negros I., Philippines, 11 fathoms).

1853. *Nassa mucronata* A. Adams, Reeve, Conch. Icon. 8: pl. 2, fig. 8.

1853. *Nassa gaudiosa* Hinds, Reeve, Conch. Icon. 8: pl. 8, fig. 48.

1853. *Nassa picta* Dunker, Reeve, Conch. Icon. 8: pl. 2, figs. 9a, b.

1876. *Nassa marratii* E. A. Smith, J. Linn. Soc. Lond., Zool. 12: 544, pl. 30, fig. 5 (San Christoval, Solomon I.).

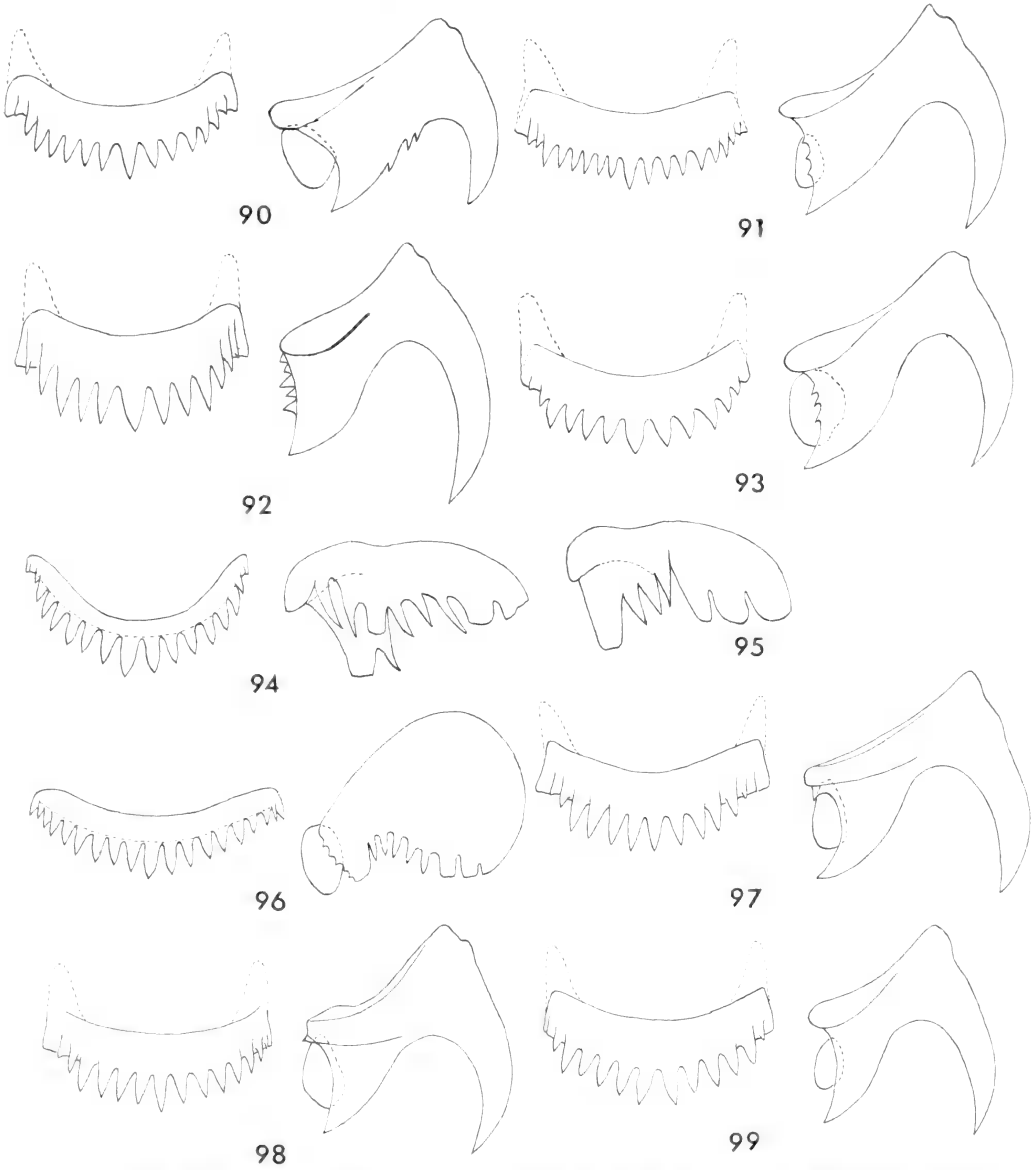
1879. *Nassa marratii* E. A. Smith, Proc. Zool. Soc. Lond. p. 809, pl. 50, fig. 8 (Andaman I.).

1913. *Nassa (Zeuxis) multipunctata* Schepman, Siboga-Exp. 49d: 321, pl. 20, figs. 4a, b. (Samau I. near Timor & Banda I., Indonesia, 9-45 m).

1957. *Nassarius pictus* Dunker, Kaicher, Indo-Pacific sea shells pl. 7, fig. 18.

Shell 12-25mm in length, slender or moderately broad, whorls regularly convex, postnuclear whorls with axial ribs and crisp spiral striae; axial ribs either persisting to the first half turn of the body whorl or becoming obsolete on the last 2½ whorls, axial ribs sometimes only indicated by sutural crenulations. Spiral striae disappear on the last 3 whorls. Columellar callus partly expanding on to the body whorl, becoming often transparent and highly glazed above the parietal wall; columella smooth, with only 1 or

2 denticles anteriorly, outer lip with 9-17 lirae which extend for a short distance into the aperture. Variable in colour, white or cream, marbled and banded with brown and lined with brown spiral lines; some individuals almost completely light or dark brown with a minimum of exposed white area. Columella white, aperture white, banded with purple-brown in light-coloured specimens, or purple-brown, banded with white in darkly coloured individuals. Operculum finely serrate at the margin.



Figs. 90-99. Half-row of radulae. 90, 91. *Nassarius (Niotha) quadrasi* (Hidalgo). Kakula I., New Hebrides. 90. ♂. 91. ♀. 92. *N. (N.) echinatus* (A. Adams). Port Havannah, New Hebrides. 93. *Nassarius (Niotha)* sp. Malolo Barrier reef, Fiji I. 94, 95. *Hebra horrida* (Dunker). Kakula I., New Hebrides. 94. ♂. 95. Lateral only ♀. 96. *H. subspinosa* (Lamarck). Olango I., Cebu I., Philippines. 97. *N. (Telasco) gaudiosus* (Hinds). Teuma Bay, New Hebrides. 98. *N. (T.) luridus* (Gould). Port Havannah, New Hebrides. 99. *N. (Zeuxis) bicallosus* (E. A. Smith). Broome, W. Australia.

TYPE LOCALITY: Straits of Malacca (Indo-Malaya).

HABITAT: In coral, muddy and black sand, from the intertidal region to a depth of 46 metres.

Material examined: Huahine, Society I.; Rarotonga, Cook I.; Oahu, Hawaiian I.; Apia, Samoa I.; Lomalagi, Fiji I.; Lifu, Loyalty I.; Kermadec I.; Teuma Bay, New Hebrides, 37 - 46 m; Pango Pt., New Hebrides; Horseshoe Bay, Magnetic I., Qld., Australia; Beaver reef, Qld., Australia; Pt. Hedland, W. Australia; The Rips, S.end of Direction I., Cocos-Keeling I.

The species is highly variable in form, sculpture and colour, and with more detailed examinations of the types, several other synonyms will undoubtedly be added in the future. *Buccinum reeveanum* Dunker, is sometimes associated with *N.luridus*, but the original description of a smooth columella disassociates the species from *luridus*.

The form *mucronata* A. Adams, (Fig. 104) is the broad, axially plicate form in which the axial ribs persist to the body whorl; the form is wide-spread and not confined to any particular geographical area.

Nassa marratii Smith (Fig. 101) is the dark brown, slender form of the species, and is also occasionally collected in the Fiji Islands. Tomlin (1940) cites *N.sesarma* Marrat, 1877, and *N.ferruginea* Marrat, 1880, as synonyms of *N.marratii*.

Kaicher (1957) has adopted the name *Buccinum kieneri* Anton, 1839, for this species, but Anton's taxon remains a *nomen dubium*.

As previously observed in temperate water Nassariidae, populations of *N.gaudiosus* from the Kermadec Islands appear to have a retarded development stage. In the majority of specimens the apertural lirae never develop and some individuals do develop a single varix on the body whorl, similarly to the S. E. Australian species *N.nigellus* (Reeve).

Nassarius (Telasco) luridus (Gould, 1849) (Figs. 98, 105 - 107)

1849. *Nassa lurida* Gould, Proc. Bost. Soc. Nat. Hist. 3: 153.

1852. *Nassa lurida* Gould, U.S. Expl. Exp. 12: 257, pl. 19, figs. 325a, b.

1852. *Nassa dispar* A. Adams, Proc. Zool. Soc. Lond. p. 96 (Philippines) [synonym *fide* Smith, 1879 and Tomlin, 1932a].

1852. *Nassa punctata* A. Adams, Proc. Zool. Soc. Lond. p. 105 (Puerto Galero, Albay, Luzon, Philippines) [non *Buccinum punctatum* Kiener, 1834 = *Nassarius*].

1852. *Nassa lentiginosa* A. Adams, Proc. Zool. Soc. Lond. p. 105 (Masbate, Philippines, 7 fathoms).

1853. *Nassa dispar* A. Adams, Reeve, Conch. Icon. 8: pl. 7, fig. 45.

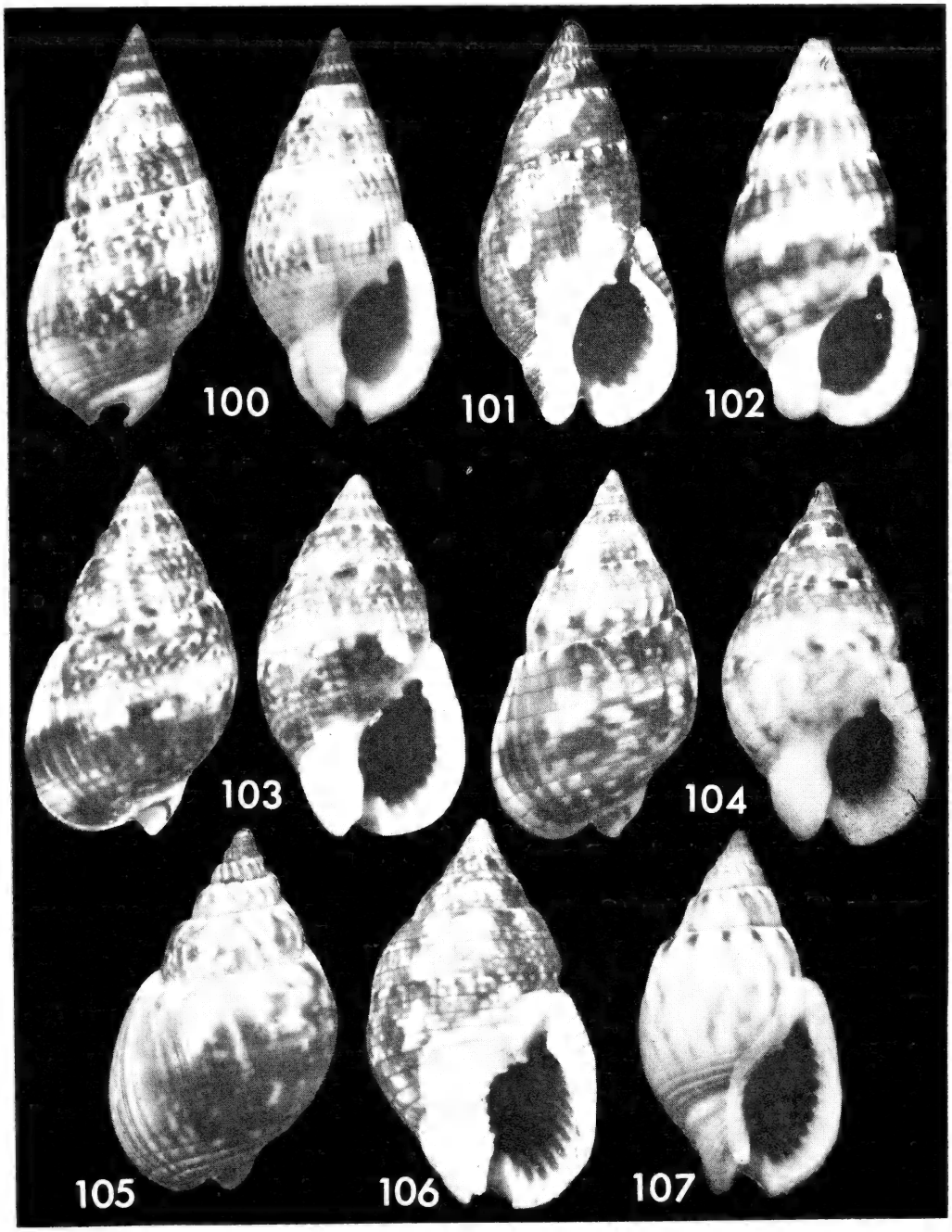
1853. *Nassa lentiginosa* A. Adams, Reeve, Conch. Icon. 8: pl. 3, fig. 15.

1853. *Nassa dispar* A. Adams, Reeve, Conch. Icon. 8: pl. 7, fig. 45.

1913. *Nassa (Arcularia) elegans* var. *fulgurans* Schepman, Siboga-Exp. 49d: 314, pl. 19, figs. 10a, b (Indonesia).

1957. *Nassarius kieneri* Anton, Kaicher, Indo-Pacific sea shells pl. 7, fig. 24 (? non *Buccinum kieneri* Anton, 1839).

1964. *Tarazeuxis reeveanus* (Dunker), Habe, Shells west. Pacific col. 2: 100, pl. 32, fig. 19 (non *Buccinum reeveanum* Dunker, 1847).



Figs. 100-107. 100-104. *Nassarius (Telasco) gaudiosus* (Hinds). 100. Slender smooth form. Pt. Hedland, W. Australia; 24.0mm. 101. Forma *marrati* E. A. Smith. Lomalagi, Fiji I.; 17.4mm. 102. Plicate form. Oahu, Hawaiian I.; 17.0mm. 103. Broad, smooth form. Teuma Bay, New Hebrides; 15.4mm. 104. Forma *mucronata* A. Adams. Pango Pt., New Hebrides; 16.0mm. 105-107. *N. (T.) luridus* (Gould). 105. Magnetic I., Qld., Australia; 19.2mm. 106. Caboni beach, Fiji I.; 18.6mm. 107. Boac, Philippines; 19.5mm.

Similar in size and general appearance to *N. gaudiosus*, but thinner and more inflated, last whorl rather ventricose. In contrast to *N. gaudiosus*, the columella with prominent, short denticles and plicae along its entire length, and in mature specimens the outer lip has 3-4 small, sharp denticles on the anterior edge. Columellar callus spreads only occasionally on to the body whorl, and usually the columella only appears calloused. Variable in colour, sometimes cream, axially streaked and spotted at sutures with brown, at other times dark green or greenish-brown, with a fine network of white lines or short streaks; columellar callus and edge of outer lip white, interior of aperture purple-brown, narrowly banded with white. Operculum serrate at the margin.

TYPE LOCALITY: Tutuila, Samoa Islands.

HABITAT: In coral and weedy sand, from the intertidal region to a depth of 18 metres.

Material examined: Watson's I., Apia, Samoa I.; Suva reef, Fiji I.; Caboni beach, Fiji I.; Port Havannah, Efate I., New Hebrides; Australia; Horseshoe Bay, Magnetic I.; Kurrimine beach; Lucinda Pt.; Four Mile beach, Port Douglas; Pt. Pallarenda near Townsville, all Queensland; Pt. Hedland, W. Australia; Boac I., Marinduque, Philippines; Doupe, Philippines.

The smooth columella in *N.gaudiosus* and the plicate and wrinkled columella in *N.luridus* aid in a quick separation of adult specimens, which sometimes may approach each other in shape and colouring.

Nassarius (Telasco) shacklefordi (Melvill & Standen, 1896) (Fig. 111)

1896. *Nassa (Telasco) shacklefordi* Melvill & Standen, J. Conch. 8: 274, pl. 9, fig. 3.

1964. *Tarazeuxis shackelfordi (sic)* (Melvill & Standen), Habe, Shells west. Pacific col. 2: 99, pl. 32, fig. 14 (Japan).

Shell 8-14mm in length, ovate and shining, early postnuclear whorls axially costate, last 2-3 whorls smooth, base of shell with about half a dozen spiral striae. Columella not calloused, smooth apart from a parietal denticle, a prominent fold anteriorly and occasionally 1-2 minute denticles; outer lip thickened, backed by a varix and with 12-15 denticles which extend as lirae into the aperture. White, pink or rose in colour, usually ornamented with wide-spaced small orange-brown spots at the sutures; under magnification, 2 bands of a latticed pattern can be observed on the dorsal side of the body whorl.

TYPE LOCALITY: Lifu, Loyalty Islands.

HABITAT: Unknown.

Material examined: Lifu, Loyalty Islands (beach-worn specimens).

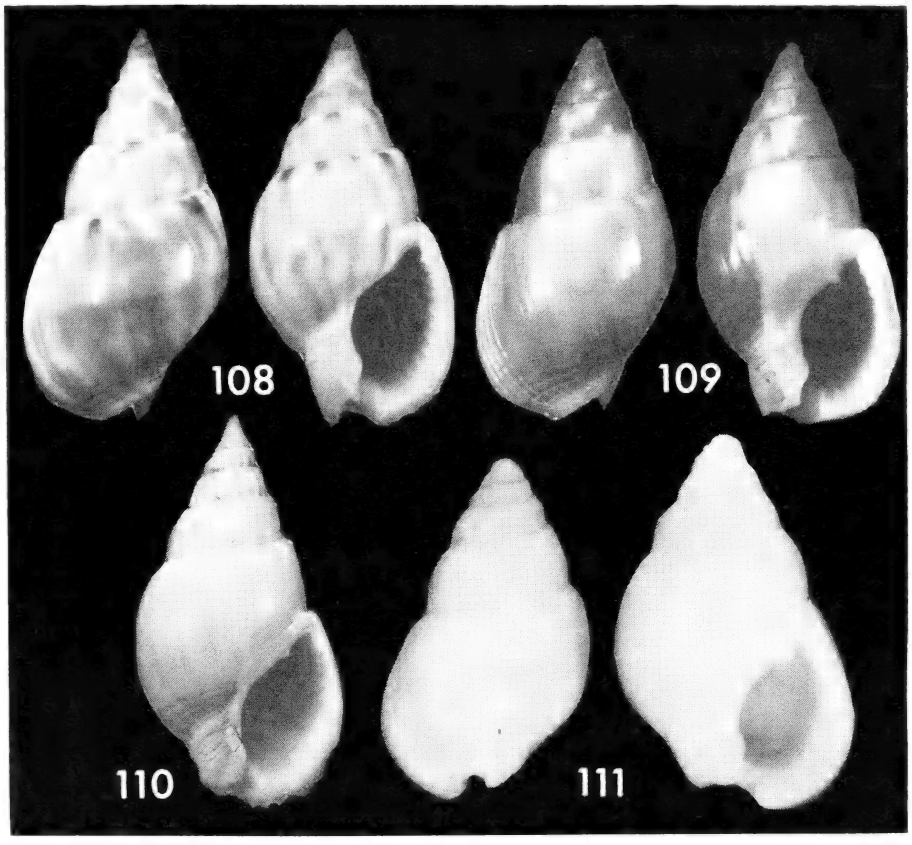
Subgenus **Zeuxis** H. & A. Adams, 1853

Zeuxis H. & A. Adams, Gen. Rec. Moll. 1: 119. Type species by SD (Cossmann, 1901) *Buccinum taenia* Gmelin, 1791 = *B. olivaceum* Bruguière, 1789. Recent, Indo-Pacific.

1929. ? *Allanassa* Iredale, Mem. Queensl. Mus. 9 (3): 289, 295. Type species by OD *Nassa eximia* H. Adams, 1872. Recent, W. Pacific.

Shell small to moderate in size, 15-45mm in length, solid, whorls convex, sculptured with axial ribs and spiral striae or grooves; aperture generally more open, columella calloused but not expanded and denticulate along its entire length. Outer lip thickened and backed by a varix, denticulate interiorly, aperture smooth or lirate within, siphonal canal short. Laterals of radula with 2 simple cusps, accessory lateral plates usually absent.

The identity of *Nassa eximia* H. Adams, is uncertain, and the described specimen could be a small *Nassarius concinnus* (Powys).



Figs. 108-111. 108-110. *Nassarius (Zeuxis) comptus* (A. Adams). 108. Pt. Hedland, W. Australia; 22.2mm. 109. Mauritius; 21.4mm. 110. Muscat, Gulf of Oman; 25.7mm. 111. *N. (Telsca) shacklefordi* (Melvill & Standen). Topotype, Lifu, Loyalty I.; 8.0mm.

Nassarius (Zeuxis) comptus (A. Adams, 1852) (Figs. 108 - 110)

1852. *Nassa compta* A. Adams, Proc. Zool. Soc. Lond. p. 107.

1853. *Nassa compta* A. Adams, Reeve, Conch. Icon. 8: pl. 16, figs. 106a, b.

1880. *Nassa polita* Marrat, Nar. shells gen. Nassa pp. 24, 79 (Mauritius).

1964. ? *Zeuxis excellens* Kuroda & Habe, Habe, Shells west. Pacif. col. 2: 100, pl. 32, fig. 22.

The species is rather similar to *N. luridus* Gould, but differs in the following features: the body whorl is more ventricose, the siphonal fasciole is less calloused, the

spire is higher and the siphonal canal is more produced. Sutures have a narrow and flat presutural ramp, and the columellar callus is thinly glazed above the parietal wall. Cream to brown in colour, shining, ornamented with orange-brown axial streaks and spots at sutures; columella and edge of outer lip white, interior of aperture light orange-brown.

TYPE LOCALITY: Cape St. Antonio, South Africa.

HABITAT: Unknown.

Material examined: Pt. Hedland, W. Australia; Mauritius; Muscat, Gulf of Oman.

There is some doubt as to the correctness of the type locality, since neither Tomlin (1928) nor Barnard (1959) report the species from South Africa.

Nassarius (Zeuxis) olivaceus (Bruguière, 1789) (Figs. 112 - 114)

1789. *Buccinum olivaceum* Bruguière, Encycl. Méth. vers 1: 272.

1791. *Buccinum taenia* Gmelin, Syst. Nat. ed. 13: 3493 (Hab: ?).

1816. *Nassa olivacea* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 394, fig. 7.

1833. *Buccinum olivaceum* Lamarck, Quoy & Gaimard, Voy. L'Astrolabe 2: 442, pl. 32, figs. 13-15 (animal).

1834. *Buccinum olivaceum* Bruguière, Kiener, Spéc. gén. icon. coq. viv. 9: 59, pl. 15, fig. 53.

1852. *Nassa mitralis* A. Adams, Proc. Zool. Soc. Lond. p. 108 (Isinimalan, Negros I., Philippines).

1853. *Nassa mitralis* A. Adams, Reeve, Conch. Icon. 8: pl. 19, fig. 128.

1868. *Nassa approximata* Pease, Amer. J. Conch. 3: 272, pl. 23, fig. 3 (Polynesia).

1957. *Nassarius taenius* Gmelin, Kaicher, Indo-Pacific sea shells pl. 7, fig. 16.

1966. *Zeuxis olivaceus* (Bruguière), Habe & Kosuge, Shells world col. 2: 63, pl. 22, fig. 38.

1966. *Zeuxis exilis* (Powys), Habe & Kosuge, Shells world col. 2: 63, pl. 22, fig. 41 (non *Nassa exilis* Powys, 1835).

Shell 25-45mm in length, solid, sculptured with axial ribs which number from 0-20 on the penultimate and from 0-17 on the body whorl; in axially ribbed specimens, interstices have short impressed grooves, but in smooth individuals spiral sculpture is absent on the last whorl with the exception of the base of the shell. Columella calloused and denticulate along entire length, outer lip with 7-14 denticles which are confined to the edge of the aperture, interior smooth, outer lip backed by a varix. Tan to dark brown in colour, occasionally ornamented with 1-2 narrow, yellow bands on the body whorl; columella and edge of outer lip violet or brown, interior of aperture brown or purplish-brown and occasionally banded.

TYPE LOCALITY: Coast of Guadeloupe, American Ocean = error! (Bourou I. and Moluccas – Quoy & Gaimard, 1833).

HABITAT: On reef flats, under rocks and coral on a sand substrate and in muddy sand, intertidal.

Material examined: Suva reef, Fiji I.; Port Douglas, Qld., Australia; Soepiori, Schouten I., W. New Guinea; Philippines: Cebu City, Cebu I.; Doural, Sorsogon: Donzol, Luzon; Ceylon; Mauritius.

Habe & Kosuge (1966) have applied the name *Nassa exilis* Powys, 1835, to the axially plicate form of *Nassarius olivaceus*. *Nassa exilis*, however, was originally described from Payta, Peru, and has been recognized by subsequent authors as a member of the West central American fauna. *Nassarius exilis* is a small, 12 - 16 mm long, common Panamanian species which only superficially resembles *N.olivaceus*.

Nassarius (Zeuxis) dorsatus (Röding, 1798) (Figs. 115 - 118)

1791. *Buccinum trifasciatum* Gmelin, Syst. Nat. ed. 13: 3489 (non Gmelin, 1791, p. 3477).

1798. *Buccinum dorsatum* Röding, Mus. Bolten. p. 111 (ref. Chemnitz, vol. 4, pl. 125, figs. 1194, 1195).

1822. *Buccinum canaliculatum* Lamarck, Hist. Nat. anim. s. vert. 7: 267 (Hab: ?) [non Gmelin, 1791].

1827. *Nassa livida* Gray in King, Narrat. Surv. Aust. 2: App. p. 484.

1834. *Buccinum canaliculatum* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 61, pl. 23, fig. 89 (Indian Ocean) [non Gmelin, 1791].

1834. *Buccinum unicolorum* Kiener, Spéc. gén. icon. coq. viv. 9: 60, pl. 19, fig. 69 (Hab: ?).

1852. *Nassa badia* A. Adams, Proc. Zool. Soc. London, p. 107 (Sinaat, N. Ilocos, Luzon, Philippines).

1853. *Nassa badia* A. Adams, Reeve, Conch. Icon. 8: pl. 19, fig. 124.

1853. *Nassa unicolorata* Reeve, Conch. Icon. 8: pl. 3, fig. 17 (N. Australia).

1853. *Nassa rutilans* Reeve, Conch. Icon. 8: pl. 22, fig. 147 (New Zealand = error!).

1957. *Nassarius canaliculatus* Lamarck, Kaicher, Indo-Pacific sea shells pl. 7, fig. 17.

1966. *Tarazeuxis unicolorus* (Kiener), Habe & Kosuge, Shells world col. 2: 62, pl. 22, fig. 30.

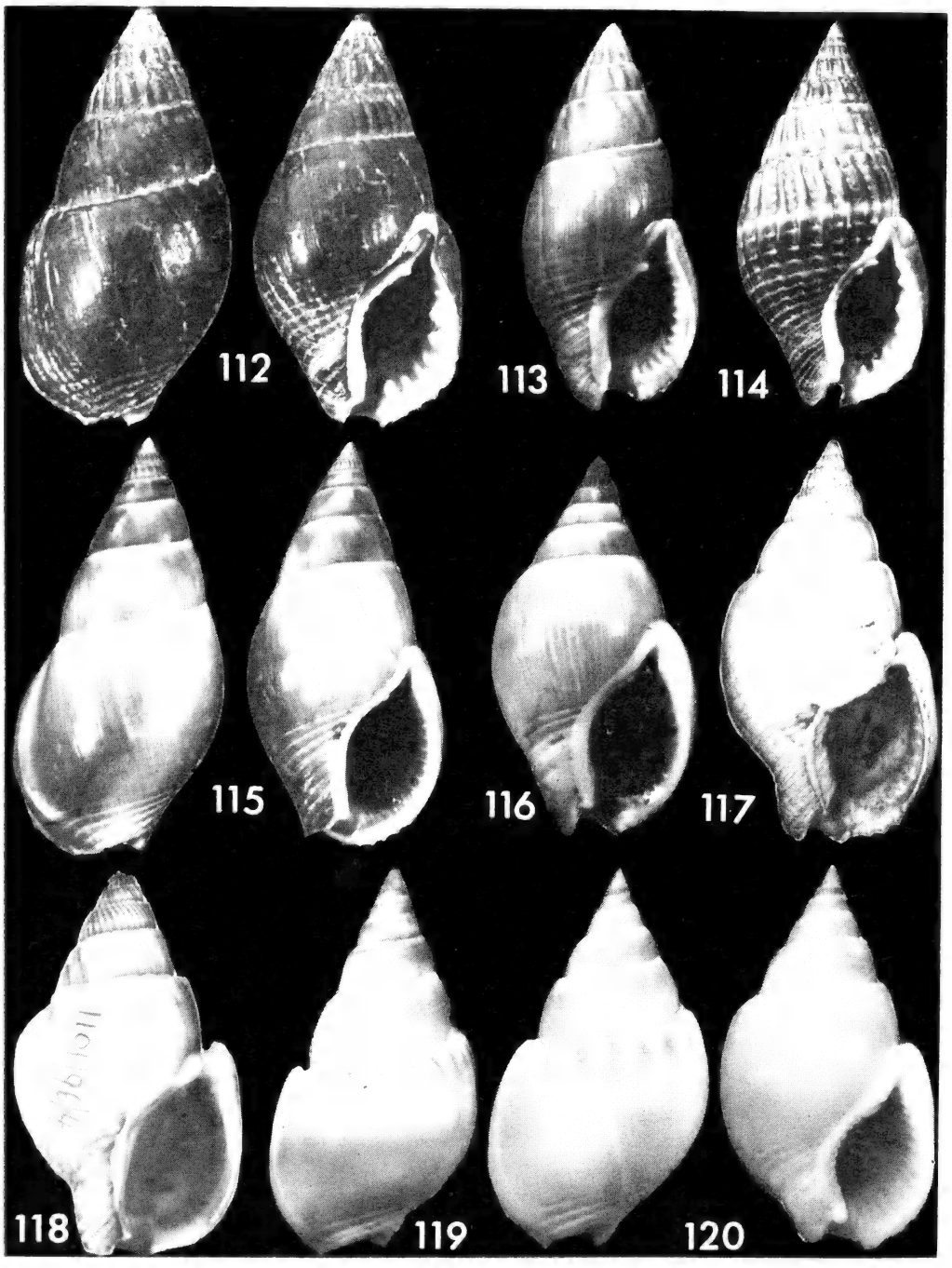
Shell 18-40mm in length, moderately thin, frequently shining, last whorl occasionally ventricose, postnuclear whorls sculptured with axial ribs and sutural nodules, last 3-4 whorls smooth; occasional individuals are weakly plicate up to the ventral side of the body whorl. The back of the outer lip has a prominent varix, base of shell with about half a dozen spiral cords. Columella calloused and finely denticulate along entire length, outer lip with short denticles which do not extend into the aperture, edge of lip with 3-4 small, spinose denticles anteriorly. Variable in colour, uniformly steel-grey, obsoletely banded with brown, some specimens tan or dark brown in colour; columella and edge of outer lip white, interior of aperture purple-brown.

TYPE LOCALITY: None. (Tranquebar – Chemnitz, 1880).

HABITAT: On reef-flats and sand-bars, intertidal.

Material examined: Australia: Gloucester I.; Lucinda Pt.; Dingo beach; Cairns; Keppel Bay; Round Hill Heads; Pt. Marlowe, Townsville, all Queensland; Broome, W.A.; Yampi Sound, W.A.; Darwin, N.A.; Sydney, N.S.W.

The syntypes of *Buccinum canaliculatum* Lamarck (non Gmelin, 1791) [Figs. 117, 118] are in the Museum d'Histoire Naturelle, Geneva, No. 1101/96, and measure 36.4 mm and 35.0 mm in length.



Figs. 112-120. 112-114. *Nasarius (Zeuxis) olivaceus* (Bruguière). 112. Suva reef, Fiji I.; 32.0mm. 113. Forma *mitralis* A. Adams. Cebu I., Philippines; 27.0mm. 114. Plicate form. Port Douglas, Qld., Australia; 33.0mm. 115-118. *N. (Z.) dorsatus* (Röding). 115. Slender form. Townsville, Qld., Australia; 32.0mm. 116. Broad form. Broome, W. Australia; 26.0mm. 117, 118. Syntypes of *Buccinum canaliculatum* (Lamarck). Mus. d'Hist. Nat. Geneva No. 1101/96, 36.4 and 35.0mm respectively. 119, 120. *Nassarius (Zeuxis) bicallosus* (E. A. Smith). Broome, West Australia. 119. Slender form; 22.0mm. 120. Broad form; 24.0mm.

Nassarius (Zeuxis) bicallosus (E. A. Smith), 1876) (Figs. 99, 119 - 120).

1876. *Nassa bicallosa* E. A. Smith, J. Linn. Soc. Lond. Zool. 12: 543, pl. 30, fig. 1.

1877. *Nassa glabella* Marrat, Prop. new forms *Nassa* p. 3, pl. 1, fig. 7 (Hab: ?).

1877. *Nassa laevigata* Marrat, Prop. new forms *Nassa* p. 3, pl. 1, fig. 7 *(Nom. subst. pro N. glabella* Marrat, 1877) [non *N. laevigata* Pusch, 1836].

1903. *Nassa optima* Sowerby, J. Malacology 10: 73, pl. 5, figs. 1, 2 (N.W. Australia).

1913. *Nassa (Alectryon) elegantula* Schepman, Siboga-Exp. 49d: 315, pl. 19, figs. 11a, b (Madura Str. and Timor).

1959. *Nassa bicallosa* Smith, Barnard, Ann. Sth. Afric. Mus. 45: 107, fig. 22h (radula), fig. 23d (protoconch).

Shell 20-28mm in length, similar to *N. dorsatus* but more ventricose, postnuclear whorls sculptured with oblique axial ribs, a presutural groove and a row of sutural nodules; axial ribs becoming obsolete on last 3-4 whorls and appearing as prominent coronations at the sutures. In some individuals, sutural nodules become obsolete. Aperture ovate, columella calloused and finely denticulate along entire length, outer lip with denticles which extend as lirae one-half to three-quarter way into the aperture; outer lip backed by a varix, anterior edge with a few, small and sharp denticles. White, cream or light fawn in colour, occasionally banded with brown on the dorsal side of the body whorl; axial ribs separated from sutural nodules by a shallow, smooth channel, reddish-brown in colour; columella and edge of aperture white, interior orange or purple-brown.

TYPE LOCALITY: Cape Natal, South Africa.

HABITAT: Sublittoral, at depth ranging from 18 - 73 metres.

Material examined: Sand banks at Yampi Sound; 2 miles E. of jetty, Broome, both W. Australia.

The species has a moderately restricted range which extends from West Australia to South Africa and Madagascar. The original localities from which the species was described were Swan River, W. Australia and Cape Natal. Tomlin (1928) remarked that the 3 syntypes of *N.bicallosus* marked by Smith as types, originated from Cape Natal.

Nassarius (Zeuxis) margaritiferus (Dunker, 1847) (Figs. 122, 141)

1833. *Buccinum reticulatum* Quoy & Gaimard, Voy. L'Astrolabe 2: 444, pl. 32, figs. 16, 17 (Vanikoro I., Solomon I.) [non Linnaeus, 1758].

1847. *Buccinum margaritiferum* Dunker, Zeit. Malakozool. 4: 60 (Hab: ?).

1849. *Buccinum margaritiferum* Dunker, Philippi, Abb. Beschr. Conch. 3: 47, pl. 1, fig. 12.

1853. *Nassa costellifera* A. Adams, Proc. Zool. Soc. Lond. p. 113 (Curimans, Philippines) [*fide* Smith, 1879, and Tomlin, 1928, 1932a]

1853. *Nassa costellifera* A. Adams, Reeve, Conch. Icon. 8: pl. 9, figs. 58a, b.

1853. *Nassa margaritifera* Dunker, Reeve, Conch. Icon. 8: pl. 9, figs. 59a, b.

1957. *Nassarius crematus* Hinds, Kaicher, Indo-Pacific sea shells pl. 7, fig. 20 (non *Nassa cremata* Hinds, 1844).

1966. *Zeuxis margaritiferus* (Dunker), Habe & Kosuge, Shells world col. 2: 62, pl. 22, fig. 31.

Shell 20-27mm in length, elongate-ovate and solid, sculptured with numerous, nodulose axial ribs which number from 20-30 on the penultimate and from 20-26 on the body whorl ;axial ribs separated from sutural nodules by a shallow, smooth channel. Interstices smooth apart from macroscopic axial striae, spiral cords commence at centre of body whorl and extend to the base. Aperture moderately small and ovate, columella calloused and denticulate along entire length, outer lip with 7-10 denticles which extend as lirae halfway into the aperture. White or cream in colour, banded, streaked and marbled with purple-brown, columella and outer lip white or cream, interior of aperture banded with purple-brown.

TYPE LOCALITY: None.

HABITAT: On reef flats, among sand, grass and coral, intertidal.

Material examined: Bushmens Bay, Malekula I., New Hebrides; Chukwani, W. Zanzibar, E. Africa.

The species has been reported from Cabinda, West Africa by Knudsen (1955). The figured specimen, which undoubtedly is *N.margaritiferus*, may have been an accidental introduction from South Africa and the species probably does not live on the west African coast.

Nassarius (Zeuxis) pyrrhus (Menke, 1843) (Figs. 121, 142)

1822. *Buccinum fasciatum* Lamarck, Hist. nat. anim. s. vert. 7: 271 (New Holland) [non Müller, 1774]

1833. *Bucccinum fasciatum* Lamarck, Quoy & Gaimard, Voy. L'Astrolabe 2: 445, pl. 32, figs. 18-21 (non Müller, 1774).

1843. *Buccinum pyrrhum* Menke, Moll Nov. Holl. p. 21 *(nom. subst. pro B. fasciatum* Lamarck, 1822) [New Holland].

1852. ? *Nassa dealbata* A. Adams, Proc. Zool. Soc. Lond. p. 112 (Dumaguete, Negros I., Philippines = error) [*fide* Tomlin, 1932].

1853. *Nassa fasciata* Quoy & Gaimard, Reeve, Conch. Icon. 8: pl. 6, fig. 40.

1913. *Alectrion fasciata* Lamarck, Suter, Man. N.Z. Moll. p. 397, pl. 45, fig. 16 (Bay of Islands, New Zealand).

1915. *Alectrion victorianus* Iredale, Trans. Proc. N.Z. Inst. 47: 467. *(nom. subst. pro Buccinum fasciatum* Lamarck, 1822).

1927. *Alectrion fasciata* (Lamarck), Finlay, Trans. Proc. N.Z. Inst. 57-418 (eliminated from the New Zealand fauna).

1962. *Niotha pyrrhus* (Menke), Macpherson & Gabriel, Mar. Moll. Vict. p. 196, fig. 233.

Shell 10-22mm in length, sculptured with slender and angulate axial ribs which number from 14-20 on the last two whorls; ribs are crossed by coarse spiral cords which divide the ribs into nodules, sutural nodules separated from the ribs by a shallow presutural groove. Columella calloused and irregularly denticulate along its entire length, denticles frequently doubled up; denticles on outer lip confined to the margin, interior of aperture smooth. White to pinkish-white in colour, ornamented with a dark rusty-brown band on the spire whorls and 2 bands on the body whorl; some specimens are brown and have yellowish-white spiral bands. Columella brown or mauve but white on the parietal wall, aperture white, narrowly banded with brown, interior of siphonal canal flushed with violet in fresh specimens.

TYPE LOCALITY: New Holland.

HABITAT: On sand banks, intertidal.

Material examined: Albany, W. Australia; Port Augusta, W.A.; Tasmania; South Australia: Henley Beach: Semaphore: Glenelg; N. of Stansbury, Yorke's Peninsula; Port Lincoln; Outer Harbour, Adelaide; Victoria: Melbourne; Phillip I.; Sandringham; Port Fairy; Cowes, Western Port.

The species is generally assigned to the subgenus *Niotha,* but on shell-characters a placement in *Zeuxis* appears more appropriate. *Nassarius pyrrhus* has been reported from New Zealand in two recent publications (Macpherson & Gabriel, 1962 and Wilson & Gillett, 1971), but it does not occur there. The specimen described by Suter (1913) from the Bay of Islands, New Zealand as *Alectrion fasciatus* Lamarck, most probably originated from Australia.

Nassarius (Zeuxis) crematus (Hinds, 1844) (Figs. 123 - 125)

1844. *Nassa cremata* Hinds, Zool. Voy. "Sulphur" p. 35, pl. 9, figs. 8, 9.

1852. *Nassa siquijorensis* A. Adams, Proc. Zool. Soc. Lond. p. 97, (Siquijor I., Philippines)

1852. *Nassa crenellifera* A. Adams, Proc. Zool. Soc. Lond. p. 98 (Hab: ?).

1853. *Nassa cremata* Hinds, Reeve, Conch. Icon. 8: pl. 4, figs. 26a, b.

1853. *Nassa siquijorensis* A. Adams, Reeve Conch. Icon. 8: pl. 8, figs. 53a, b.

1853. *Nassa crenellifera* A. Adams, Reeve, Conch. Icon. 8: pl. 8, fig. 49.

1879. *Nassa siquijorensis* A. Adams, E. A. Smith, Proc. Zool. Soc. Lond. p. 210, pl. 20, figs. 45, 45a.

1880. *Nassa quadrata* Marrat, Var. shells gen. *Nassa* p. 103 (Singapore) [*nom. subst. pro N. cremata* Reeve, 1853]

1914. *Nassa euglypta* Sowerby, Proc. Malac. Soc. Lond. 11: 6, textfig. (Kii, Japan).

1931. *Nassa (Hinia) kueneni* Koperberg, Jaarb. Mijn. Ned. Indie p. 112, pl. 3, fig. 44 (Pliocene of Timor).

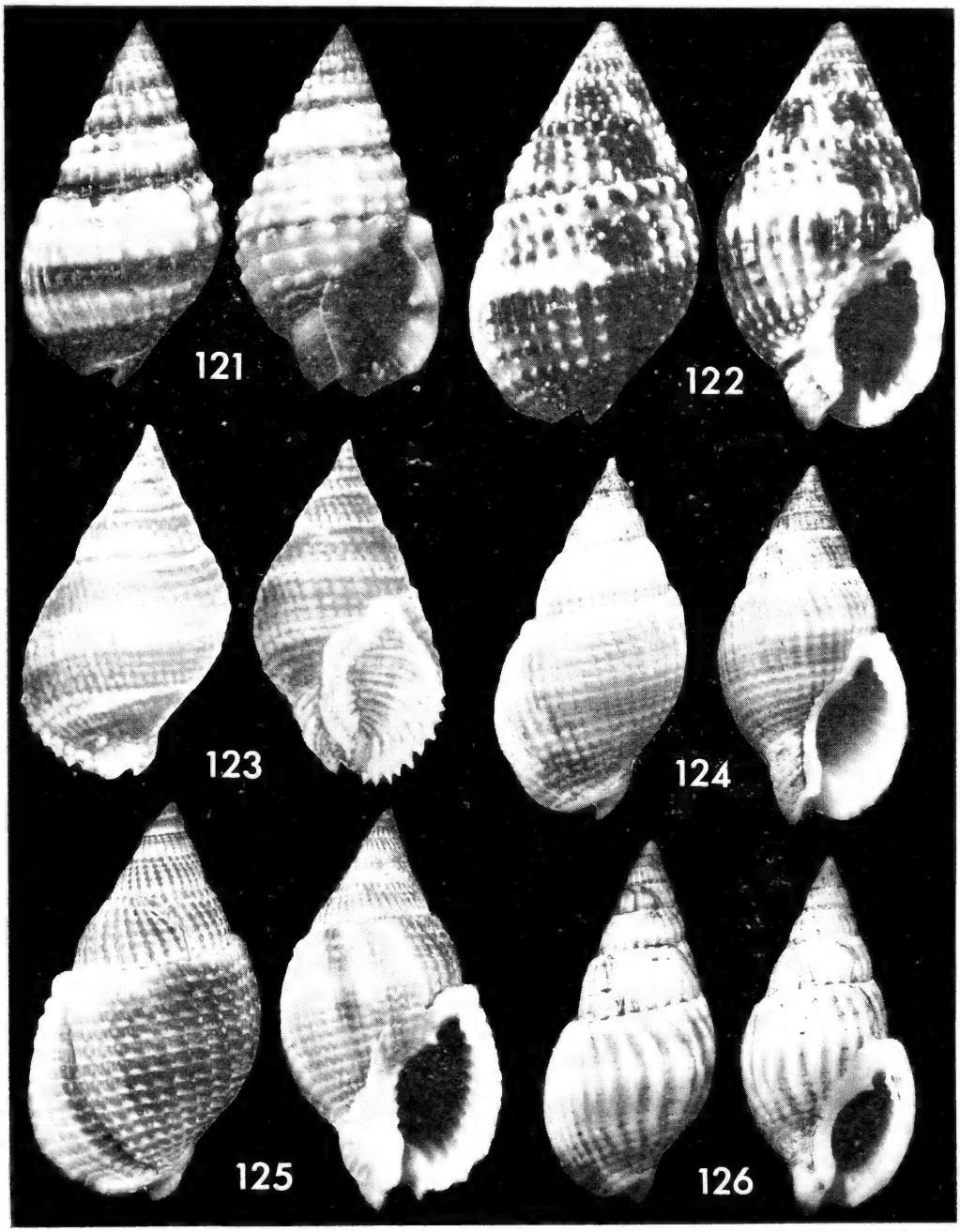
1934. *Nassa crenata* Giner-Marí, J. Conchyl. 78: 15, 64 *(nom. van.).*

1934. *Nassa crenata* var. *scutulata* Giner-Marí, J. Conchyl. 78: 16 *(nom. subst. pro N. cremata* Reeve, 1853).

Shell 12-30mm in length, moderately ventricose, sculptured with numerous, close-set and slender axial ribs which number from 25-40 on the last 2 whorls; spiral cords decussate axial ribs into small nodules and form 5-7 rows on the penultimate and 14-15 rows on the body whorl. The longitudinally oriented nodules are separated from the axial ribs by a shallow presutural groove. Columella calloused and in some individuals broadly laminated anteriorly, and with 5-10 denticles or plicae which are generally more prominent at the base; outer lip with 10-13 lirae which extend one-half to three-quarter way into the aperture, lip margin with small and sharp denticles. White, cream, fawn or light grey in colour, ornamented with 2-3 moderately broad, brown bands on the body whorl, bands occasionally more saturated on the dorsal side; columella and edge of outer lip white, aperture frequently flushed with brown.

TYPE LOCALITY: Straits of Malacca.

HABITAT: In coral sand, from the intertidal region to a depth of 10 metres.



Figs. 121-126. 121. *Nassarius (Zeuxis) pyrrhus* (Menke). Sandringham, Vict., Australia; 18.0mm; 122. *N. (Z.) margaritiferus* (Dunker). Malekula I., New Hebrides; 21.4mm. 123-125. *N. (Z.) crematus* (Hinds). 123. Type figure (from Hinds, 1844, pl. 9, figs. 8, 9). 124. Tosa Bay, Japan; 29.3mm. 125. Manava I., Fiji I.; 22.0mm. 126. *N. (Z.) caelatus* (A. Adams). Tokyo Bay, Japan; 27.5mm.

Material examined: Diamond Head, Oahu, Hawaiian I.; Manava I., Fiji I., 11 m; Horseshoe Bay, Magnetic I., Qld., Australia; Daydream I., Whitsunday Passage, Qld., Australia; Mantoewoeri Pt., Koeroedoi I., Geelvink Bay, W. New Guinea, 7 m; Tosa Bay, Japan; Minoshima, Wakayama - Ken, Japan; Tokushima, Japan.

Several names have been bestowed on this species, some of them based on such variable features as number of axial ribs and density of spiral cords. *Nassa euglypta* Sowerby, is frequently placed in the synonymy of the related *Nassarius caelatus* A. Adams, but Sowerby's species is the spirally decussate *N.crematus*.

There is a possibility that *Nassa conoidalis* Deshayes in Bélanger, 1832, may be a prior name for *Nassarius crematus*, but the true identity of the species is rather dubious. Kiener (1834) figures under the name *Buccinum conoidale* a species very similar to *Nassarius albescens gemmuliferus* (A. Adams), and the figure supplied by Tryon (1822) appears to be *N.distortus* (A. Adams). Hedley (1915) equals *Buccinum conoidale* to *Nassa cremata* Hinds, and considers *N.ravida* A. Adams, 1852, to be a synonym. Oostingh (1939) follows Hedley and also includes *Nassa (Hinia) kurodai* Makiyama, 1927, in the synonymy of *N.conoidalis*. Makiyama's species appears to be *Nassarius crematus* (Hinds). In view of the different applications of the name and the dubious identity of *Buccinum conoidale*, *Nassarius crematus* (Hinds) has been retained for the species.

Nassarius (Zeuxis) caelatus (A. Adams, 1852) (Figs. 126, 143)

1852. *Nassa caelata* A. Adams, Proc. Zool. Soc. Lond. p. 97.

1853. *Nassa caelata* A. Adams, Reeve, Conch. Icon. 8: pl. 20, fig. 133.

1927. *Nassarius (Hinia) caelatus dainitiensis* Makiyama, Mem. Coll. Sci. Kyoto Univ., ser. B 3 (1): 122, pl. 5, figs. 17, 18.

1959. *Nassarius (Zeuxis) caelatus* (A. Adams), Kira, Col. Illust. shells Jap. 1: 73, pl. 28, fig. 16.

1961. *Zeuxis eugylptus (sic)* Sowerby, Habe, Col. Illust. shells Jap. 2: 65, pl. 32, fig. 24 (non *Nassa euglypta* Sowerby, 1914).

1967. *Zeuxis caelatus* (A. Adams), Habe & Kosuge, Stand. Book Jap. shells col. 3: 76, pl. 29, fig. 35.

Shell 20-30mm in length, similar to *N. crematus*, but differs in the following features: axial ribs are slightly broader, wider spaced and less numerous than in *N. crematus* and smooth on the last 2 whorls. The shell is not spirally corded but has short, finely incised grooves in the interstices of the axial ribs; spiral cords become apparent towards the base where they override axial ribs. Sutural nodules are separated from the ribs by a continuous presutural groove. The species is yellowish-cream, and nebulously banded with brown on the body whorl.

TYPE LOCALITY: Cagayan, Mindanao, Philippines, in 25 fathoms.

HABITAT: On sandy mud substrate, sublittoral.

Material examined: Tokyo Bay, Japan.

Tomlin (1940), who examined Marrat's type specimens of Nassariidae, lists *Nassa elongata* Marrat, 1874 (non *Buccinum elongatum* J. de Sowerby, 1815),

N.oblonga Marrat, 1877, *N.sinensis* Marrat, 1877, *N.oriens* Marrat, 1880, and *N.lactea* Marrat, 1880, as synonyms of *Nassarius caelatus* (A. Adams).

Nassarius (Zeuxis) vitiensis (Hombron & Jaquinot, 1853) (Figs. 127 - 130, 144)

1834. *Buccinum crenulatum* Bruguière, Kiener, Spéc. gén. icon. coq. viv. 9: 62, pl. 23, fig. 90 (non Linnaeus, 1758).

1853. *Nassa crenulata* Bruguière, Reeve, Conch. Icon. 8: pl. 1, fig. 2 (non *Buccinum crenulatum* Bruguière, 1789).

1853. *Nassa vitiensis* Hombron & Jaquinot, Voy. Pole Sud Astr. Zélée, Atlas, pl. 21, figs. 23-25.

1854. *Nassa vitiensis* Hombron & Jaquinot, Voy. Pole Sud Astr. & Zélée, text 5: 79.

1880. ? *Nassa cingenda* Marrat, Var. shells gen. *Nassa* p. 102 (fide Tomlin, 1940 [Hab: ?].

1925. *Nassa incognita* Thiele, Wiss. Erg. Deut. Tief.-Exp. "Valdivia" 17: 183, pl. 20, fig. 11 Dar-es-salaam, E. Africa).

1966. *Zeuxis crenulatus* (Lamarck) var. Habe & Kosuge, Shells world col. 2: 63, pl. 22, fig. 36.

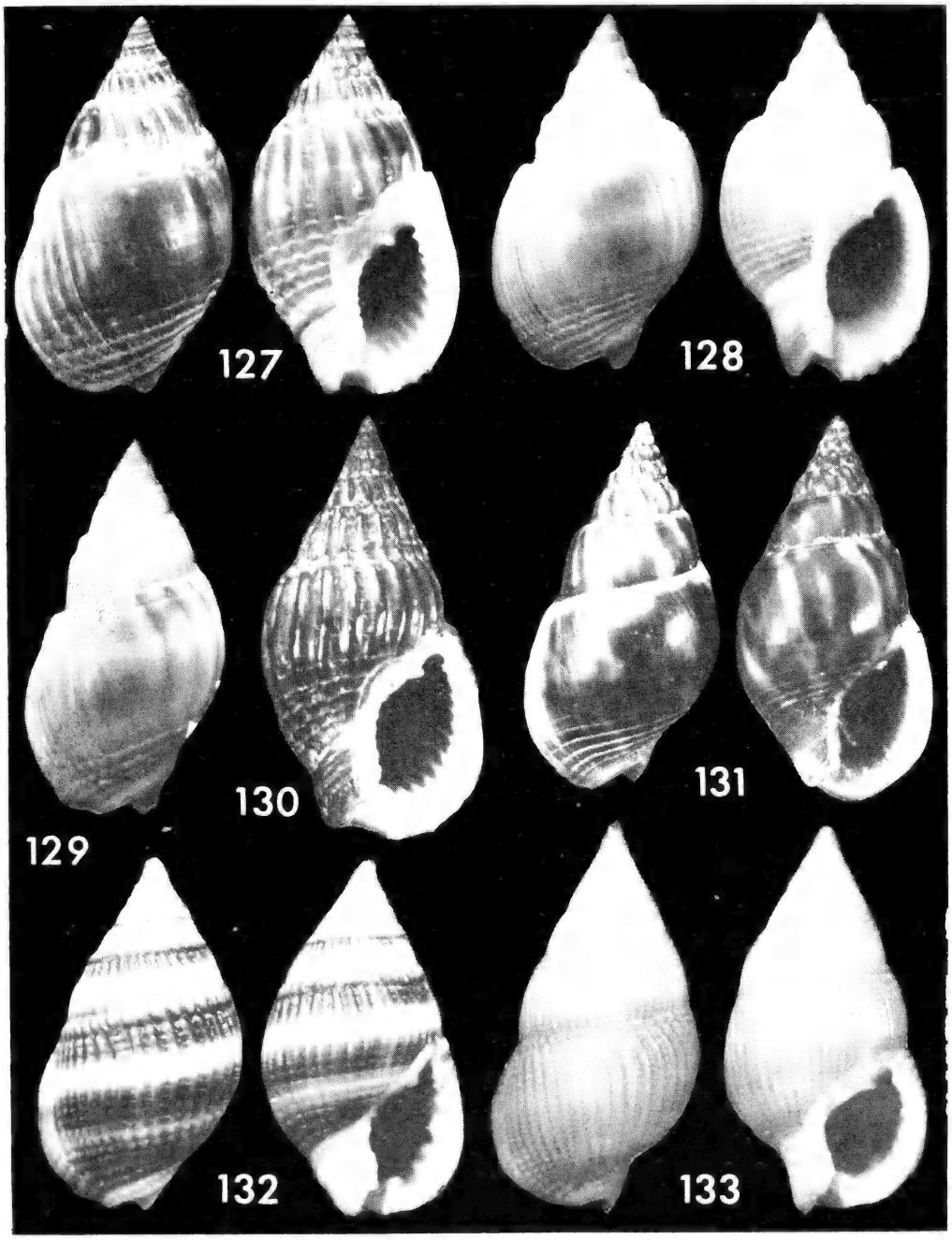
Shell 20-30mm in length, similar to *N. caelatus* in form, number of axial ribs and apertural features, but differs in the following characters: axial ribs become obsolete in a small area on the dorsal side of the body whorl, and the impressed intersticial spiral grooves are fewer, weaker and at times absent. The anterior of the columella in *N. vitiensis* is laminated but tends to be more impressed on to the body whorl in *N. caelatus*. Creamy-grey, broadly banded on the body whorl with dark brown, or steel-grey in colour, and banded with dark grey; some individuals are uniformly dark brown with patches of yellowish-brown on the dorsal side of the body whorl and the sutural girdle, or creamy-white, with traces of broad bands on the dorsum of the body whorl. Columella and edge of outer lip white, interior of aperture violet or purple-brown. Operculum serrated at the margin.

TYPE LOCALITY: Fiji Islands.

HABITAT: In weedy and muddy sand, from the intertidal region to a depth of 46 metres.

Material examined: Apolima Strait, W. Samoa; Caboni beach, Fiji I.; Port Havannah, Efate I., New Hebrides; Teuma Bay, New Hebrides, 46 m; Rabaul, New Britain; Mios Woendi, Geelvink Bay, W. New Guinea, 2 - 4 m; Yorkey's Knob, N. of Cairns, Qld., Australia; Hongkong; Chango I., Zanzibar, 26 - 29 m.

This species is the *Nassarius crenulatus* of authors, not of Bruguière, 1789. The identity of Bruguière's species has never been satisfactorily solved, and his only reference not accompanied by a query is to Petiver (pl. 64, fig. 8), an illustration which has been cited for the Mediterranean *Buccinum reticulatum* Linnaeus. The *Nassa crenulata* Lamarck, 1816, appears to be the species *N.scalaris* A. Adams, 1852. Bruguière's taxon is a homonym of *Buccinum crenulatum* Linnaeus, 1758, and *Nassa vitiensis* Hombron & Jaquinot appears to be the next available name, provided an earlier name is not available from among A. Adams' unfigured *Nassa* species.



Figs. 127-133, 137-130. *Nassarius (Zeuxis) vitiensis* (Hombron & Jaquinot). 127. Topotype. Caboni beach, Fiji I.; 21.7mm. 128. Fine-ribbed form. Mios Woendi, Geelvink Bay, W. New Guinea; 24.2mm. 129. Slender form. Chango I., W. Zanzibar; 26.0mm. 130. Dark brown form. Teuma Bay, New Hebrides; 21.0mm. 131. *N. (Z.) flammulatus* (Schepman). Teuma Bay, New Hebrides; 15.5mm. 132, 133. *N. (Z.) concinnus* (Powys). 132. Broad form. Lomalagi, Fiji I.; 12.0mm. 133. Slender form. Mauritius; 18.0mm.

Nassarius (Zeuxis) flammulatus (Schepman, 1913) (Figs. 131, 145)

1913. *Nassa (Alectryon) flammulata* Schepman, Siboga-Exp. 49d: 314, pl. 19, figs. 12a, b.

Shell 14-16mm in length, whorls convex, protoconch glassy golden-brown with a darker brown sutural band and a peripheral keel, postnuclear whorls sculptured with strong axial ribs and spiral striae. On the last two whorls sculpture becomes obsolete apart from 2-4 finely incised spiral striae at the sutures and 5-6 striae towards the base; the body whorl suture is tabulate. Columella calloused but not expanded, plicate along its entire length, aperture lirate for a short distance from the outer lip. Flesh to yellowish-brown in colour, ornamented with dark brown axial flames, back of outer lip whitish; columella and edge of outer lip light orange-brown, interior of aperture purple-brown. The operculum of one specimen examined was smooth, the other feebly serrated at the margin.

TYPE LOCALITY: Ruma-Kuda Bay, Roma I., Indonesia, 36 metres, mud and sand.

HABITAT: Sublittoral, in muddy sand, from 27 - 46 metres.

Only a few specimens of this rare species were available and its relationship to *Nassarius vitiensis* remains obscure. The protoconchs of the two species are identical, but the postnuclear whorls in *N.vitiensis* have a row of sutural nodules, whereas in some specimens of *N.flammulatus* these are only feebly indicated. Both species have been taken from the same dredge-haul in the New Hebrides, but since the radula of *N.flammulatus* has an intermediate lateral plate which is lacking in *N.vitiensis*, combined with differences in shell-morphology, the two species are considered tentatively distinct.

Nassarius (Zeuxis) concinnus (Powys, 1835) (Figs. 132, 133)

1835. *Nassa concinna* Powys, Proc. Zool. Soc. Lond. pt. 3: 95.

1853. *Nassa concinna* Powis, Reeve, Conch. Icon. 8: pl. 13, fig. 82 & pl. 14, fig. 91 (figd. type).

1874. *Nassa concentrica* Marrat, Ann. Mag. Nat. Hist. 13: 71 *(nom. subst. pro N. concinna* Powys, 1835).

1877. *Nassa smithii* Marrat, Prop. new forms *Nassa* p. 7 (types labelled "Singapore" *fide* Tomlin, 1940).

1877. *Nassa rotundicostata* Marrat, Prop. new forms *Nassa* p. 8 (Hab: ?).

1877. *Nassa cribraria* Marrat, Prop. new forms *Nassa* p. 12, pl. 1, fig. 20 (types labelled "Philippines" *fide* Tomlin, 1940).

1877. *Nassa smithii* Marrat, J. Conch. 1: 204.

1964. *Zeuxis concinnus* (Powys), Habe, Shells west. Pacific col. 2: 100, pl. 32, fig. 23.

1966. *Allanassa concinna* (Powys), Habe & Kosuge, Shells world col. 2: 62, pl. 22, fig. 32.

Shell 10-20mm in length, whorls convex and frequently swollen anteriorly in large mature individuals, spire long or moderately short, sculptured with numerous, regular and close-set axial ribs which number from 30-50 on the penultimate and from 25-40 on the body whorl; a moderately deep spiral groove separate a row of sutural nodules from the axial ribs. Narrow interstices with numerous fine spiral striae which extend on to the wall of the axial ribs, rarely crossing them. Columella calloused without being expanded and with 5-10 denticles or short plicae, outer lip with 7-9 short lirae, siphonal

canal short. White to cream in colour, penultimate whorl with a dark brown sutural band, body whorl with 3 broad bands; columella and outer lip white, aperture banded with brown.

TYPE LOCALITY: Tubuai I., Austral Islands.

HABITAT: In coral sand, sublittoral to a depth of 47 metres.
Material examined: Tahiti, Society I.; Rarotonga, Cook I.; Apia Harbour, Upolu I., Samoa I.; Lomalagi, S. Viti Levu, Fiji I.; Teuma Bay, Efate I., New Hebrides, 47 m; Daydream I., Whitsunday Passage, Qld., Australia; Mauritius.

Subgenus **Alectrion** Montfort, 1810

Alectrion Montfort, 1810, Conch. Syst. 2: 566. Type species by OD *A. papillosus* = *Buccinum papillosum* Linnaeus, 1758. Recent, Indo-Pacific.

1827. *Alectryon* Berthold in Latreille, Nat. Fam. Thierr. pp. 187, 564 *(nom. null.)*.

Shell moderate in size, 25-50mm in length, occasionally inflated, sometimes moderately thin, sculptured with prominent or obsolete axial ribs or spinose nodes; columella calloused but not expanded, completely smooth apart from a parietal denticle. Outer lip only moderately thickened, lirate or completely smooth; edge of outer lip frequently with spinose denticles. Laterals of radula with 2 simple cusps, but occasionally denticulate in between cusps and on outward edge of the inner cusp; accessory lateral plate is present.

Nassarius (Alectrion) papillosus (Linnaeus, 1758) (Fig. 134)

1758. *Buccinum papillosum* Linnaeus, Syst. Nat. ed. 10: 737.

1816. *Buccinum papillosum* Lamarck, Tabl. Encycl. Méth. p. 2, pl. 400, figs. 2a, b.

1834. *Buccinum papillosum* Linnaeus, Kiener, Spéc. gén. icon. coq. viv. 9: 58, pl. 15, fig. 54.

1929. *Nassa (Alectryon) papillosa* var. *seminuda* Dautzenberg, Moll. test. mar. Madagascar, p. 203 (ref. Tryon, 1882, pl. 9, figs. 71, 74).

1957. *Nassarius papillosus* Linné, Kaicher, Indo-Pacific sea shells pl. 7, fig. 25.

1964. *Cominella (Eucominella) nassoides fovcauxana* Powell, Shikama, Sel. shells world col. 2: 120, pl. 65, fig. 6 (non Powell, 1946).

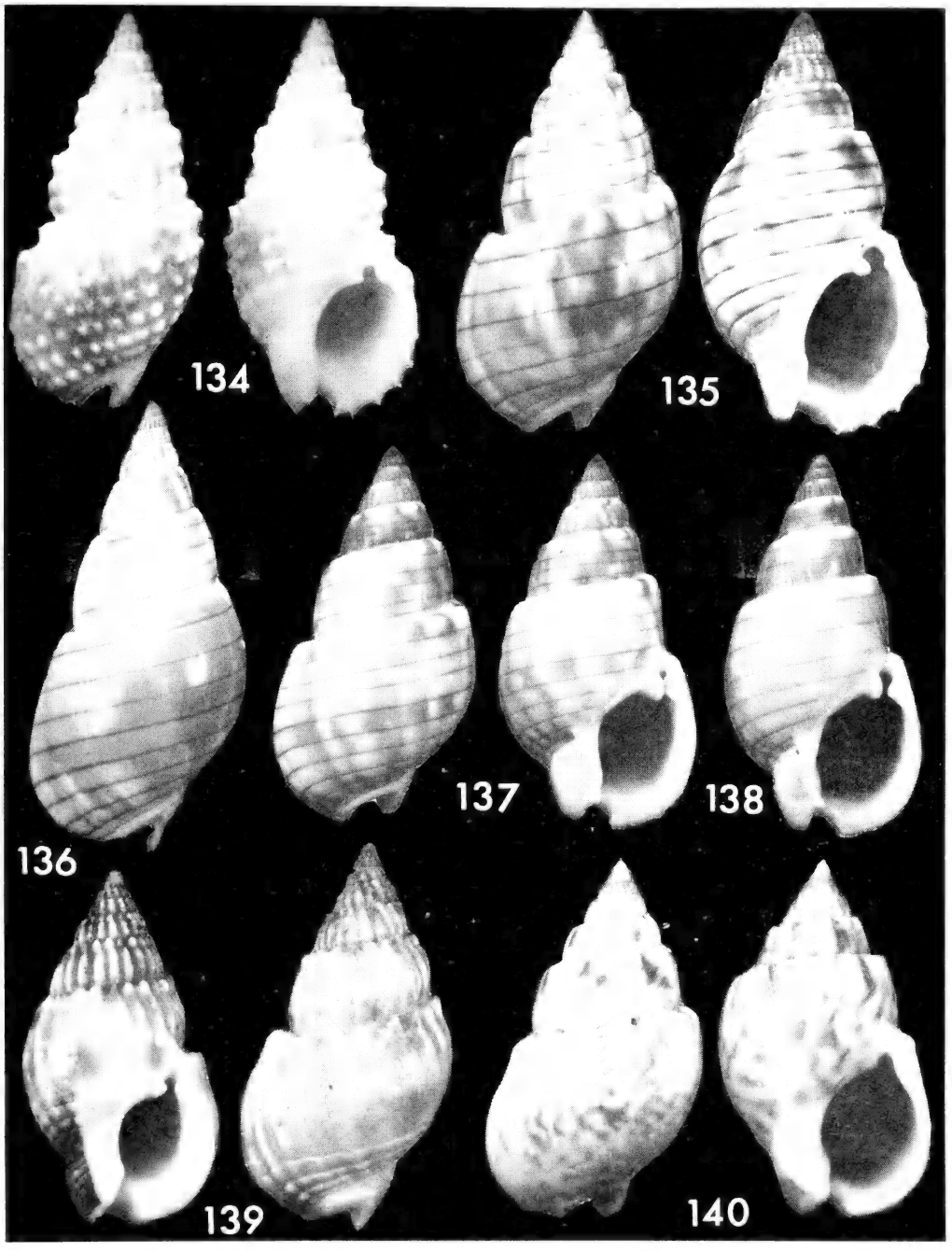
1967. *Alectrion papillosus* (Linné), Habe & Kosuge, Shells world col. 2: 63, pl. 22, fig. 37.

Shell 27-50mm in length, sculptured with spiral rows of bluntly spinose or rounded nodules which are connected by feeble or prominent axial ribs; presutural ramp frequently angulate, sutural nodules smaller than the rest. Interstices of nodules with longitudinal striae. Columella calloused and only slightly spreading on to the body whorl, smooth apart from a parietal denticle; aperture finely striate, margin of outer lip with spinose denticles. Cream in colour, irregularly blotched or clouded with orange-brown or rusty-red; columella and aperture cream in colour.

TYPE LOCALITY: Asiatic Ocean.

HABITAT: In coral sand, intertidal and sublittoral.

Material examined: Tahiti, Society I.; Rarotonga, Cook I.; Manava I., Fiji I.; Philippine I.; Amboina, Indonesia; Mauritius.



Figs. 134-140. 134. *Nassarius (Alectrion) papillosus* (Linnaeus). Amboina, Indonesia; 45.5mm. 135, 136. *N. (A.) glans glans* (Linnaeus). 135. Noduled form, Anse Vata, Noumea, New Caledonia; 27.3mm. 136. Smooth form, Nuku'alofa, Tonga I.; 51.0mm. 137, 138. *N. (A.) glans particeps* (Hedley). 137. Long reef, Sydney, Australia; 22.7mm. 138. Port Jackson, Sydney, Australia; 30.5mm. 139. *N. (A.) hirtus* (Kiener). Kakaako, Honolulu, Hawaiian I.; 25.0mm. 140. *N. (A.) spiratus* (A. Adams). Matapouri, N.E. of Whangarei, New Zealand; 21.0mm.

Nassarius (Alectrion) glans glans (Linnaeus, 1758) (Figs. 135 - 136, 146)

1758. *Buccinum glans* Linnaeus, Syst. Nat. ed. 10: 737.

1780. *"Buccinum lineatum glans"* Chemnitz, Syst. Conch. Cab. 4: 60, pl. 125, figs. 1196-1200 *(non. binom.).*

1798. *Buccinum lineatum* Röding, Mus. Bolten. p. 112 (ref. Chemnitz, op. cit., figs. 1196, 1197) [non da Costa, 1778].

1811. *Ancilla lineata* Perry, Conchology pl. 31, fig. 7.

1816. *Buccinum glans* Lamarck, Tabl. Encycl. Méth. p. 2, pl. 400, figs. 5a, b.

1822. *Buccinum suturale* Lamarck, Hist. Nat. anim. s. vert. 7: 269 (Hab: ?).

1834. *Buccinum glans* Linnaeus, Kiener, Spéc. gén. icon. coq. viv. 9: 54, pl. 15, fig.52.

1834. *Buccinum suturale* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 55, pl. 24, fig. 96 (Mauritius).

1866. *Nassa intermedi*a Dunker, Verh. zool-bot. Gesell. Wien 16: 909 (Sydney, Australia = ? error) [non Forbes, 1844].

1867. *Nassa (Alectrion) intermedia* Frauenfeld, "Novara" Exp. Zool. Moll. 2 (3): 5, pl. 1, fig. 2.

1908. *Nassa suturalis dunkeri* Suter, Trans. Proc. N.Z. Inst. 40: 350 *(nom. subst. pro N. intermedia* Dunker, 1866).

1945. *Nassarius (Alectrion) glans* (Linné), Habe, Jap. J. Malac. 14: 195, fig. 18 (radula).

1957. *Nassarius glans* Linnaeus, Kaicher, Indo-Pacific sea shells pl. 7, fig. 13.

1967. *Alectrion glans* (Linnaeus), Habe & Kosuge, Stand. book Jap. shells 3: 76, pl. 29, fig. 37.

Shells 25-52mm in length, moderately thin and inflated, postnuclear whorls sculptured with axial ribs and overriding spiral cords, last 2-3 whorls smooth, sutures either smooth or crenulate. Columella calloused and laminated anteriorly, smooth apart from a parietal denticle, aperture smooth; outer lip with short lirae and spiny denticles at the margin in mature specimens. White to cream in colour, ornamented with brown spiral bands and occasionally axial flames and blotches of the same colour; columella and aperture cream in colour, upper spire whorls frequently flushed with rose or violet. Operculum serrate at the margin.

TYPE LOCALITY: Asiatic Ocean.

HABITAT: In silty and weedy coral sand, intertidal and sublittoral.

Material examined: Nuku'alofa, Tonga I.; Manava I., Fiji I.; Australia: Bowen; Kurrimine beach; Cape Moreton, 117 m; Horseshoe Bay, Magnetic I., all Queensland; Plage de Poe, Bourail, New Caledonia; Anse Vata Bay, Noumea, New Caledonia; off Korak I., Babelthuap, Palau I.; Mikawa, Japan; Kagashima Bay, Japan, 9 m.

Nassarius (Alectrion) glans particeps (Hedley, 1915) (Figs. 137 - 138, 147)

1853. *Nassa suturalis* var. Reeve, Conch. Icon. 8: pl. 2, figs. 11a, b (Hab: ?) [non *Buccinum suturale* Lamarck, 1822].

1913. *Alectrion suturalis* subsp. *dunkeri* Suter, Man. N.Z. Moll. p. 398, pl. 45, fig. 17 (non *Nassa suturalis dunkeri* Suter, 1908) [Kermadec I.; Cuvier I., New Zealand = error?].

1915. *Alectrion suturalis* subsp. *dunkeri* (Suter), Iredale, Trans. Proc. N.Z. Inst. 47: 467.

1915. *Arcularia particeps* Hedley, Proc. Linn. Soc. N.S.W. 39: 738 (ref. Reeve, pl. 2, fig. 11 and Marrat, 1877, pl. 1, fig. 3).

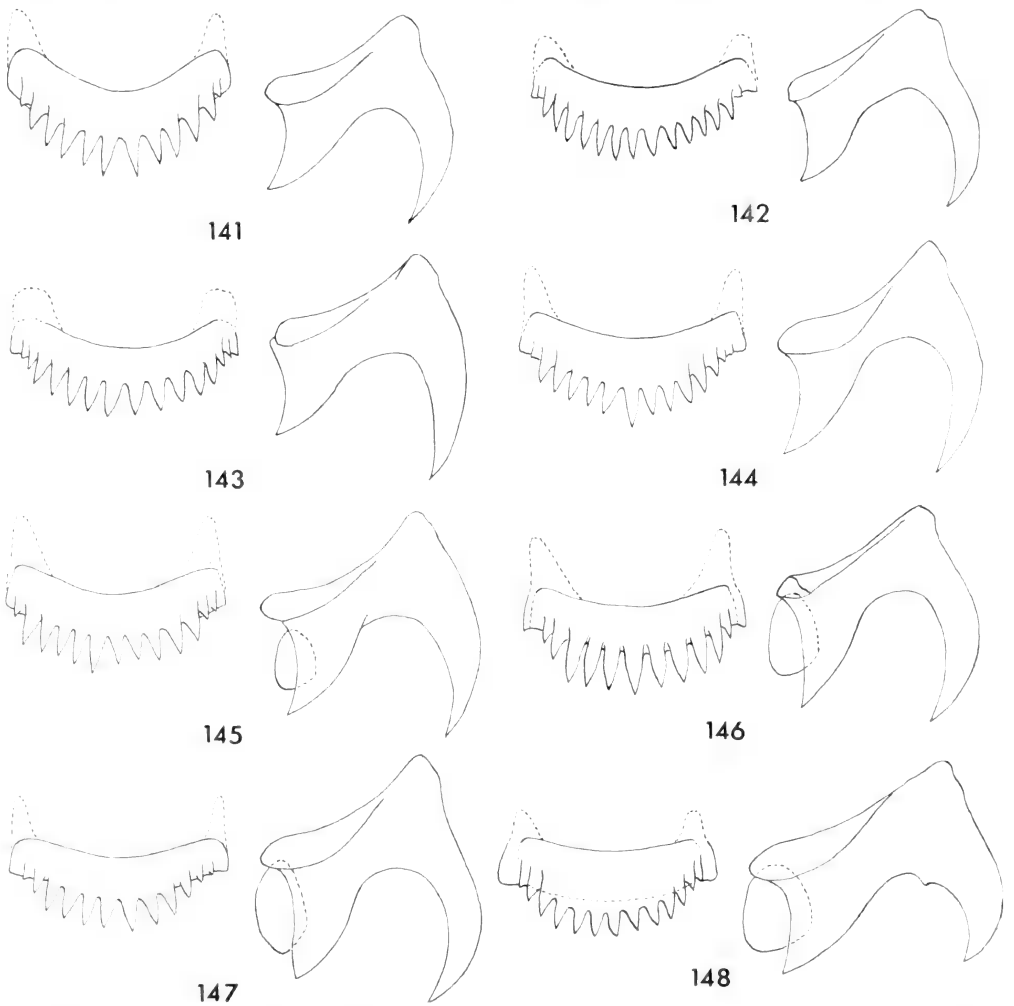
1917. *Arcularia particeps* Hedley, Proc. Linn. Soc. N.S.W. 41 (4): 712, pl. 49, fig. 20 (animal).

1927. *Alectrion suturalis* subsp. *dunkeri* Suter, Finlay, Trans. Proc. N.Z. Inst. 57: 419.

1952. *Nassarius particeps* (Hedley), Powell, Rec. Auckland Inst. Mus. 4: 181 (Cavalli I., New Zealand).

1962. *Alectrion particeps* (Hedley), Macpherson & Gabriel, Mar. Moll. Vict. p. 193, fig. 230.

Similar to *N. glans* (Linnaeus), but smaller, rarely exceeding 32.0mm in length, body whorl generally less ventricose, sutures of last 2 whorls not crenulate, denticles



Figs. 141-148. Half-row of radulae. 141. *Nassarius (Zeuxis) margaritiferus* (Dunker). Chukwani, Zanzibar. 142. *N. (Z.) pyrrhus* (Menke). Sandringham, Vict., Australia. 143. *N. (Z.) caelatus* (A. Adams). Tokyo Bay, Japan. 144. *N. (Z.) vitiensis* (Hombron & Jaquinot). Port Havannah, New Hebrides. 145. *N. (Z.) flammulatus* (Schepman). Teuma Bay, New Hebrides. 146. *N. (Alectrion) glans glans* (Linnaeus). Anse Vata, Noumea. New Caledonia. 147. *N. (A.) glans particeps* (Hedley). Shellharbour, N.S.W., Australia. 148. *N. (A.) spiratus* (A. Adams). Matapouri, New Zealand.

on margin of outer lip either absent or only feebly developed anteriorly. Similar in colour to *N. glans*, but the rosy or violet cast on the spire whorls usually extends to the penultimate whorl.

TYPE LOCALITY: Sydney, Australia.

HABITAT: In sand pools, intertidal and sublittoral.

Material examined: Australia: Port Jackson; Long reef, Sydney; Kurnell, Botany Bay; Shellharbour; Manly; Cronulla, all New South Wales. New Zealand: Cavalli I.

When Hedley described the temperate water species *N.particeps*, he based his separation between his new species and the tropical *N.glans* on the following differences: absence of sutural beads, evanescence of prickly denticles on the outer lip, more slender shape and a broad sutural shelf or gutter in *N.particeps*. In the nominate species, the sutural crenulations are usually only present in small specimens and become absent in large adults, but in the subspecies *particeps* the sutural nodules are always absent. Tabulated sutures are a feature common to both, and the sutural shelf varies in width in individuals. Although the majority of specimens of the subspecies *particeps* are less inflated at the body whorl, occasional ventricose individuals are encountered. The small, prickly denticles are usually not as prominent in *N.particeps* as in *N.glans*, but some large individuals of the former do have 3 - 4 denticles anteriorly; in small, immature specimens of the tropical *glans*, the denticles are also absent.

In view of the overlap in size and diagnostic characters of *particeps* and *glans*, the former has been reduced to a subspecies of the latter.

Nassarius (Alectrion) hirtus (Kierner, 1834) (Fig. 139)

1834. *Buccinum hirtum* Kiener, Spéc. gén. icon. coq. viv. 9: 63, pl. 19, fig. 72.

1853. *Nassa hirta* Kiener, Reeve, Conch. Icon. 8: pl. 1, fig. 1 (Swan River, New Holland = error!).

1952. *Alectrion hirtus* (Kiener), Tinker, Pacif. sea shells, p. 82, pl. facing page, bottom figs.

1957. *Nassarius hirtus* (Kiener), Kaicher, Indo-Pacific sea shells pl. 7, fig. 14.

Shell 20-35mm in length, solid, sutures narrow and channelled, whorls convex, sculptured with slender and close-set axial ribs which tend to become obsolete on the last whorl, especially on the dorsal side; axial ribs constricted below sutures, forming a row of sutural coronations. Postnuclear whorls spirally corded, but interstices on the last 2-3 whorls are smooth; base of shell with up to half a dozen spiral cords which are occasionally granulose. Columella calloused, smooth apart from a parietal denticle, outer lip thick, backed by a varix and lirate for a short distance inside the aperture. Yellowish-brown to tan in colour, some sutural nodules paler, occasionally nebulously banded with darker brown; columella and aperture white.

TYPE LOCALITY: New Holland and Tongatabu = error!

HABITAT: Intertidal and sublittoral.

Material examined: Kakaako, Honolulu, Hawaiian I.

The species has been credited with a wide geographical distribution but appears to be confined to the Hawaiian chain. The species is represented in the collections of the National Museum of Natural History, Washington, only from the Hawaiian Islands, with a similar but coarsely sculptured form from Wake I. (Dr. H. A. Rehder, *in litt.*). The species may have been confused with the Indian Ocean *Nassarius nodiferus* (Powys), which would account for the erroneous locality indications.

Nassarius (Alectrion) spiratus (A. Adams, 1852) (Figs. 140, 148)

1852. *Nassa spirata* A. Adams, Proc. Zool. Soc. Lond. p. 106.

1853. *Nassa spirata* A. Adams, Reeve, Conch. Icon. 8: pl. 2, figs. 13a, b.

1882. *Nassa glans* var. *elegans* Kiener *(pars)*, Tryon, Man. Conch. 4: 27, pl. 8, fig. 49 (non *Buccinum elegans* Kiener, 1834).

1910. *Alectrion spiratus* A. Adams, Iredale, Proc. Malac. Soc. Lond. 9: 77.

1952. *Nassarius spiratus* (A. Adams), Powell, Rec. Auckland Inst. Mus. 4: 182.

1968. *Nassarius (Alectrion) spiratus* (A. Adams), Ponder, Rec. Dom. Mus. 6: 41, pl. 1, figs. 11, 12 (radula & operculum).

Shell 15-22mm in length, body whorl suture tabulated, first 2 postnuclear whorls axially ribbed and spirally corded, axial ribs persisting to penultimate whorl but becoming obsolete on the body whorl. Columellar callus thickened anteriorly but thin and glazed above the parietal wall, columella smooth except for a parietal denticle, outer lip edentulous, aperture smooth. Cream in colour, ornamented with irregular, short, reddish-brown lines and arrow-shaped markings, and short axial streaks at sutures; protoconch white, first 2 postnuclear whorls flushed with light purple or violet. Columellar callus and edge of aperture white, interior of aperture light orange-brown.

TYPE LOCALITY: Swan River, Australia.

HABITAT: In sand-pools, intertidal.

Material examined: Shellharbour, N.S.W., Australia; Coral Bay, Sunday I., Kermadec I.; Norfolk I.; Lord Howe I.; New Zealand: Matauri Bay, N. Auckland; Whangaroa; Cavalli I.; Tom Bowling Bay; Kaitoke, Gt. Barrier I.; Arid I., Gt. Barrier I.; Takau Bay; Matapouri, N.E. of Whangarei.

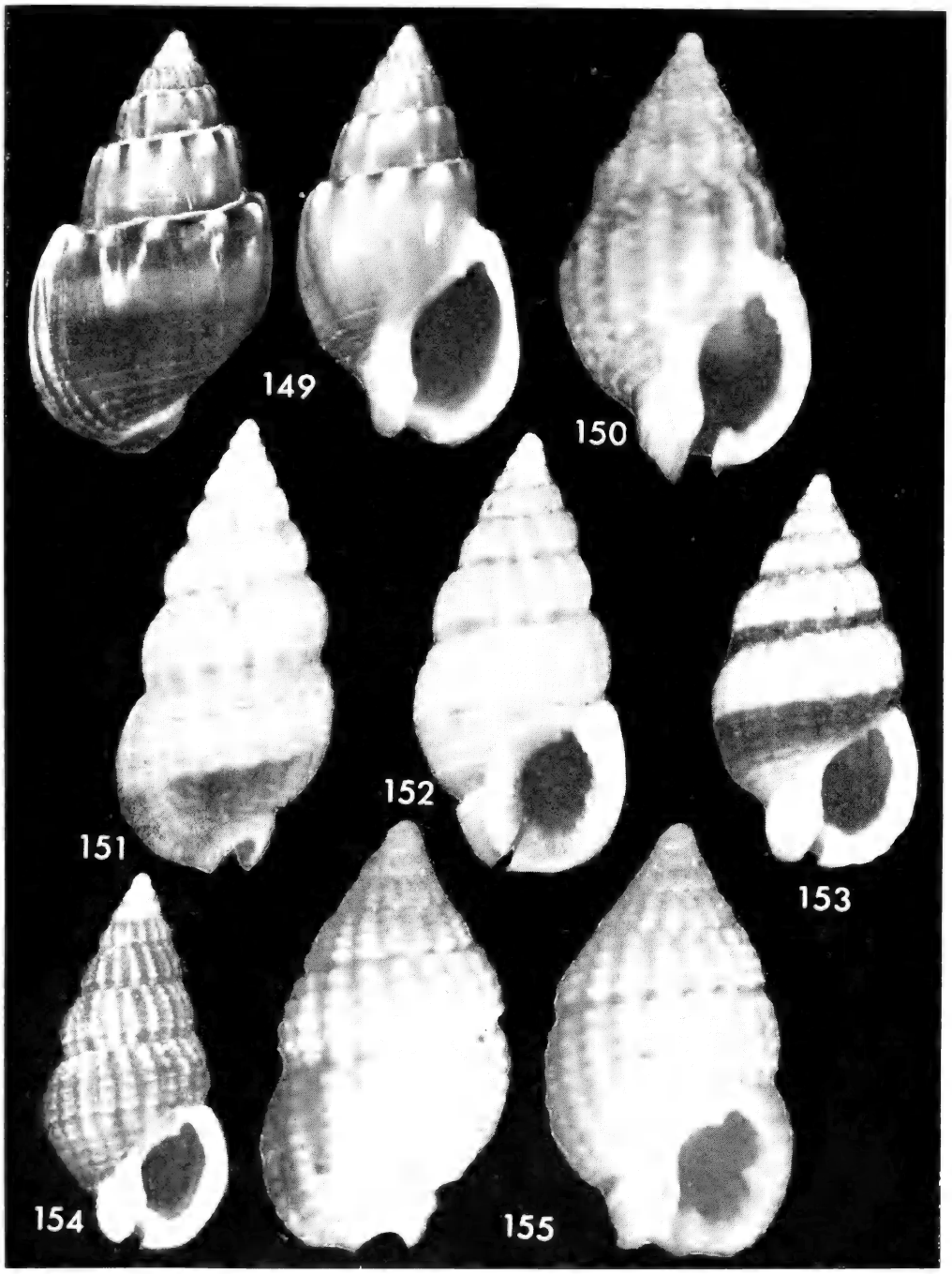
The radula of *Nassarius spiratus* examined by Ponder (1968) from Doubtless Bay, New Zealand, had laterals which were minutely denticulate between the 2 cusps.

Nassarius (Alectrion) aoteanus Finlay, 1927 (Figs. 149, 156 - 159)

1915. *Arcularia coronata* var. E. A. Smith, Brit. Ant. (Terra Nova) Exp., Zool. 2 (4): 85, pl. 1, fig. 28 (non *Buccinum coronatum* Bruguière, 1789).

1927. *Nassarius aoteanus* Finlay, Trans. Proc. N.Z. Inst. 57: 419 *(nom. subst. pro Arcularia coronata* E. A. Smith, 1915).

1968. *Nassarius (Alectrion) aoteanus* Finlay, Ponder, Rec. Dom. Mus. 6 (4): 41, pl. 1, figs. 13, 14 (radula & operculum).



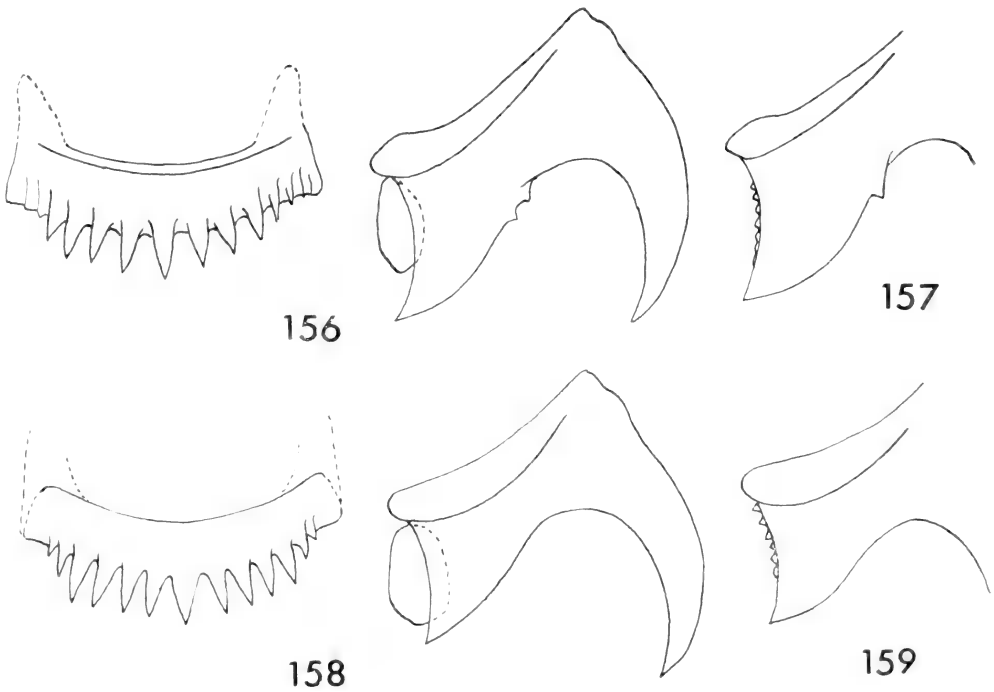
Figs. 149-155. 149. *Nassarius (Alectrion) aoteanus* Finlay. Bergen's Pt., Doubtless Bay, New Zealand; 27.0mm. 150. *Nassarius (Hima) incrassatus* (Ström). Melilla, Morocco, N. Africa; 11.0mm. 151-154. *N. (H.) pauperus* (Gould). 151. Pango Pt., New Hebrides; 12.4mm. 152. Manava L., Fiji I.; 11.0mm. 153. Port Jackson, Sydney, Australia; 10.5mm. 154. Dark brown variant from same locality; 12.6mm. 155. *N. (H.) rotundus* (Melvill & Standen. Topotype. Lifu, Loyalty I.; 6.8mm.

Shell 20-30mm in length, sutures tabulated, first 3 postnuclear whorls with axial ribs and fine spiral grooves, grooves becoming obsolete on last 2 whorls, and if present, confined to sutures; axial ribs on last 2 whorls most prominent at sutures where they become coronate and weaken towards the base. Base of shell with about half a dozen spiral grooves, back of outer lip thickened by 2-3 crowded axial ribs. Columellar callus partly overlapping on to the body whorl, slightly thinner and glazed above parietal wall; columella smooth apart from a parietal denticle, outer lip edentulous, aperture smooth. In mature specimens, the edge of the outer lip has a few, small and blunt denticles. Tan to brown in colour, ornamented with 1-2 faint, broad and darker brown bands on the body whorl and dark brown spots between the sutural coronations; columellar callus and edge of outer lip white, interior of aperture brown.

TYPE LOCALITY: Near North Cape, New Zealand, 11 - 20 fathoms.

HABITAT: Sublittoral, from 13 - 113 metres, in sandy mud.

Material examined: New Zealand: Tryphena, Gt. Barrier I.; Outer Hauraki Gulf; Between Outer Chicken I. and Mokohinau, 113 m; Kaitoke, Gt. Barrier I.; off Cuvier I., 73 m; off Alderman I., 275 m (dead specimens); off Hen & Chicken I.; Whangamumu Harbour, E. coast North I., 11 - 13 m; Oke Bay and Ninepin Rock, Bay of Islands, 55 m; Cradock Channel, between Little and Gt. Barrier I., 37 m; Bergen's Pt., Doubless Bay, 37 m.



Figs. 156-159. Half-row of radulae of *Nassarius (Alectrion) aoteanus* Finlay. 156. Oke Bay, Bay of Islands, New Zealand. 157. Denticulate lateral tooth from same radula. 158. Whangamumu Harbour, New Zealand. 159. Denticulate lateral tooth from same radula.

Subgenus **Hima** Leach in Gray, 1852

Hima Leach in Gray, 1852, Moll. Brittan. Synop. p. 123. Type species by SD (Marwick, 1931) *Buccinum minutum* Pennant, 1777 = *B. incrassatum* Ström, 1768. Recent, Mediterranean.

1852. *Tritonella* A. Adams, Proc. Zool. Soc. Lond. p. 111 (non Swainson, 1839).

1936. *Reticunassa* Iredale, Rec. Aust. Mus. 19 (5): 322. Type species by OD *Nassa paupera* Gould, 1850. Recent, Indo-Pacific.

Shell small, 5-15mm in length, elongate-ovate or ovate, sutures distinct, whorls prominently convex, sculptured with axial ribs and spiral striae; aperture short and roundly ovate, columella calloused and plicate or wrinkled, outer lip usually denticulate and backed by a varix, siphonal canal short. Laterals of radula with 2 simple cusps, accessory lateral plate present.

Confusion surrounds the usage of *Tritonella* A. Adams and *Hima* Leach in Gray. Anderson (1964) cites *Tritonella* A. Adams in H. & A. Adams, 1853, as a subgenus of *Hinia* Leach in Gray, 1847, and the same arrangement is adopted by Nordsieck (1968). Shuto (1969) uses *Tritonella* A. Adams in H. & A. Adams, as a subgenus of *Tritia* Risso, 1826, and considers the type to be *Buccinum incrassatum* Ström (Fig. 150) by original designation. The genus *Tritonella* has been erected by A. Adams already in 1852, with 12 included species and no designated type; the species *B.incrassatum* was included by A. Adams *(loc.cit.)* in the synonymy of *Nassa (Tritonella) ascanias* Bruguière, 1789. A year later H. & A. Adams placed *Tritonella* in the synonym of *Hima* Leach in Gray, 1852, without designating a type. *Tritonella* A. Adams, 1852, is not available as it is a primary homonym of *Tritonella* Swainson, 1839, in Amphibia.

The genus *Hima* was established with 3 included species, i.e. *H.minuta* (Pennant), *H.reticulata* (Linnaeus) and *H.laevigata* Leach in Gray. Since the species *Buccinum incrassatum* Ström was not cited by name, Cossmann's (1901) and Dall's (1908) designations of this species as the type of *Hima* are invalid. Woodring's (1928) designation does not appear to be valid either, as the sentence "if *Hima minuta* (Pennant) is taken as the type of *Hima*" is a designation made in an ambiguous and qualified manner (art. 67(c) of ICZN). The next valid type designation of *Hima* is the one by Marwick (1931).

Nassarius (Hima) pauperus (Gould, 1850) (Figs. 151 - 154)

1850. *Nassa paupera* Gould, Proc. Bost. Soc. Nat. Hist. 3: 155.

1852. *Nassa paupera* Gould, U.S. Expl. Exp. 12: 262, pl. 19, figs. 330a, b.

1860. *Nassa microstoma* Pease, Proc. Zool. Soc. Lond. p. 145 (Hawaiian I.) [publ. February-May 1860].

1860. *Nassa dermestina* Gould, Proc. Bost. Soc. Nat. Hist. 7: 331 (Kikaigashima, Ryukyu I.) [publ. September, 1860].

1860. *Nassa plebecula* Gould, Proc. Bost. Soc. Nat. Hist. 7: 332 (Amami-O-Shima, Ryukyu I.).

1864. *Nassa tringa* Souverbie in Souverbie & Montrouzier, J. Conchyl. 12: 272, pl. 10, fig. 7 (New Caledonia).

1865. *Nassa microstoma* Pease, Carpenter, Proc. Zool. Soc. Lond. p. 516.

1869. *Nassa balteata* Pease, Amer. J. Conch. 5: 71, pl. 8, fig. 5 (Ebon I., Marshall I.).

1877. *Nassa scalarina* Marrat, Prop. new forms *Nassa*, p. 12, pl. 1, fig. 27 (Hab: ?).

1964. *Nassa dermestina* Gould, Johnson, Bull U.S. Nat. Mus. 239: 67, pl. 16, fig. 1 (figd. holotype).

1964. *Nassa plebecula* Gould, Johnson, Bull. U.S. Nat. Mus. 239: 128, pl. 16, fig. 6 (figd. lectotype).

1965. *Nassa microstoma* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.) Zool., Suppl. 1: 24, pl. 3, figs. 5, 6 (figd. holotype = *spec. juv.*).

Shell 8-16mm in length, spire generally long, whorls convex, fusiformly elongate to fusiformly-ovate, sculptured with prominent and moderately thick axial ribs and spiral threads; spiral striae either discreet or prominent and override axial ribs. Columella calloused, minutely plicate or finely denticulate in mature specimens, outer lip backed by a varix and denticulate on the interior, aperture smooth, siphonal canal short. Variable in colour, creamy-white to creamy-yellow, occasionally banded with brown, some individuals uniformly brown; columellar callus and aperture white or cream.

TYPE LOCALITY: Pacific Ocean.

HABITAT: In coral sand, intertidal and sublittoral.

Material examined: Apia Harbour, Upolu, Samoa I.; Luatuanu'u, Upolu, Samoa I.; Manava I., Fiji I.; Lifu, Loyalty I.; Pango Pt., Efate I., New Hebrides; Norfolk I.; Fumba, S.W. Zanzibar, E. Africa. Australia: Yorke's Peninsula, Sth. Australia; Port Willunga, S.A.; Balmoral, N.S.W.; Port Jackson, N.S.W.; Long reef, Sydney, N.S.W.; Kurnell, Botany Bay, N.S.W.; Cronulla, N.S.W.; Cape Moreton, Qld.; Jumpin Pin Bar, Qld.

The species is rather common and very variable in colour and shape and consequently has received several names. *Tritia (Tritonella) crenulicostata* Shuto, 1969, from the Neogene of the Philippines, is very similar, if not conspecific with *Nassarius pauperus* (Gould).

Nassarius (Hima) rotundus (Melvill & Standen, 1896) (Fig. 155)

1896. *Nassa (Niotha) rotunda* Melvill & Standen, J. Conch. 8: 273, pl. 9, fig. 2.

Shell 5-7mm in length, globular, whorls flatly convex, sutures sharply incised, sculptured with close-set axial ribs which are rendered granulose by overriding spiral cords. Aperture short and rounded, columella calloused and shortly plicate, outer lip backed by a prominent varix; outer lip denticulate, lirae extending halfway into the aperture. Cream in colour, faintly banded and stained with yellowish-brown, columellar callus and aperture white.

TYPE LOCALITY: Lifu, Loyalty Islands.

HABITAT: Unknown.

Material examined: Lifu, Loyalty I.

No other specimens, apart from those from the type locality, have been seen.

Subgenus **Aciculina** A. Adams, 1853

Aciculina A. Adams, 1853, Proc. Zool. Soc. Lond. p. 114. Type species by SD (Cossmann, 1901) *Nassa vittata* A. Adams = *Aciculina vittata* A. Adams, 1853. Recent, Indo-Pacific (29 April 1853).

1853. *Aciculina* H. & A. Adams, Gen. Rec. Moll. 1: 121 (August 1853).

Shell small, 10-15mm in length, elongate-ovate, often terebroid in shape, spire long, whorls almost flat, smooth or sculptured with axial ribs and spiral grooves; aperture very short and narrowly ovate, columella calloused but not expanded, parietal denticle prominent, columella denticulate anteriorly. Outer lip thickened and backed by a varix, interior of lip denticulate, aperture partially lirate. Radula unknown.

Nassarius (Aciculina) vittatus (A. Adams, 1853) (Figs. 161, 162)

1853. *Aciculina vittata* A. Adams, Proc. Zool. Soc. Lond. p. 114.

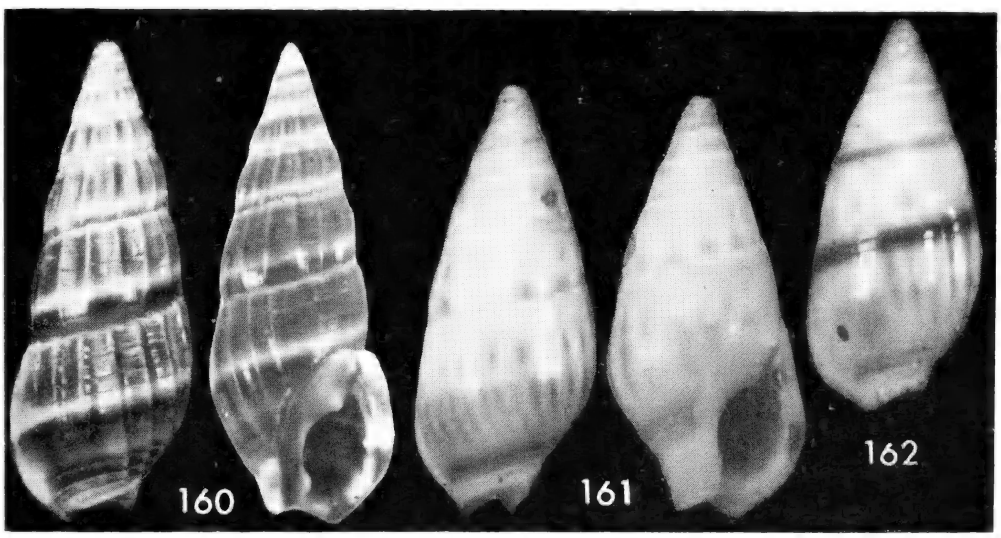
1853. *Nassa vittata* A. Adams, Reeve, Conch. Icon. 8: pl. 24, figs. 160a, b.

Shell 10-15mm in length, smooth and shining, postnuclear whorls smooth apart from a presutural groove, sculptured with angulate axial ribs which become stronger on the last whorl; wide-spaced and finely incised spiral grooves encircle the shell, base with a few spiral cords. Aperture short and narrow, columellar callus thick and prominent and with 2-5 small denticles anteriorly; outer lip backed by a prominent varix, interior with 6-8 denticles which extend as lirae for a short distance into the aperture. White to creamy-white in colour, ornamented with reddish-brown, short or long axial streaks or lines, and occasionally with a dark brown band at the sutures of the body whorl and another at the base; columellar callus and aperture white.

TYPE LOCALITY: Ticao I., Philippines, in 6 fathoms.

HABITAT: In coral and muddy sand, sublittoral.

Material examined: Colombo, Ceylon.



Figs. 160-162. 160. *Nassarius (Aciculina) labiatus* (A. Adams). Manava I., Fiji I.; 14.0mm
161, 162. *N. (A.) vittatus* (A. Adams). Colombo, Ceylon; 13.0mm and 11.0mm respectively.

Nassarius (Aciculina) labiatus (A. Adams, 1853) (Fig. 160)

1853. *Aciculina costata* A. Adams, Proc. Zool. Soc. Lond. p. 114 (Hab: ?) [non *Nassa costata* A. Adams, 1852].

1853. *Nassa labiata* A. Adams, Proc. Zool. Soc. Lond. p. 114 (April 1853).

1853. *Nassa labiata* A. Adams, Reeve, Conch. Icon. 8: pl. 24, fig. 159.

1853. *Nassa terebroides* Reeve, Conch. Icon. 8: pl. 24, fig. 161 *(nom. subst. pro Aciculina costata* A. Adams, 1853 [December 1853].

Shell 10-15mm in length, similar to *N. vittatus* but the sutures are deeper and the whole shell has angulate axial ribs from the first mature whorl to the edge of the outer lip of the last whorl; interstices of ribs wide, concave, and wide-spaced, finely incised spiral grooves encircle the shell, aperture very short and narrow. Columella prominently calloused and with an inward-turned tooth anteriorly and a denticle on the parietal wall; outer lip backed by a varix, interior margin denticulate. Brown in colour, shining, ornamented with a creamy-white or yellow band adjacent to the sutures on the spire whorls and a central band on the body whorl, and occasionally another, fainter band a short distance below. Columella white, stained with brown on the margin, interior of aperture brown, banded with white.

TYPE LOCALITY: Malacca, in 10 fathoms.

HABITAT: In coral and muddy sand, intertidal and sublittoral.

Material examined: Manava I., Fiji I.; Malapoa Pt., Vila Harbour, New Hebrides.

Genus **Hebra** H. & A. Adams, 1853

Hebra H. & A. Adams, 1853, Gen. Rec. Moll. 1: 120. Type species by SD (Cossman, 1901) *Buccinum muricatum* Quoy & Gaimard, 1833 (non Schröter, 1805) = *B. horridum* Dunker, 1847. Recent, Indo-Pacific.

1939. *Scabronassa* Peile, Proc. Malac. Soc. Lond. 23: 276. Type species by OD *Buccinum horridum* Dunker, 1847.

Shell small, rarely exceeding 20mm in length, squat and ovate, sculpture spinose, spiral cords usually prominent, spire short, whorls angulate; aperture small and ovate, columellar callus generally weakly spreading on to the body whorl, plicate or prominently wrinkled. Siphonal canal short. The radula differs from other Nassariidae: the rachidians are very low and bow-shaped, while the laterals are complicated in structure, being humped, and having squared cusps which are reminiscent of some species of Columbellidae.

Hebra horrida (Dunker, 1847) (Figs. 81 - 83, 89, 94 - 95)

1833. *Buccinum muricatum* Quoy & Gaimard, Voy. L'Astrolabe 2: 450, pl. 32, figs. 32, 33 (non Schröter, 1805).

1834. *Buccinum muricatum* Quoy & Gaimard, Kiener, Spéc. gén. icon. coq. viv. 9: 93, pl. 27, fig. 110 (non Schröter, 1805).

1846. *Buccinum scabrum* Dunker, Zeit. Malakozool. 3: 171 (Hab?) [non Anton, 1839].

1847. *Buccinum horridum* Dunker, Zeit. Malakozool. 4: 59 *(nom. subst. pro B. scabrum* Dunker, 1846).

1849. *Buccinum horridum* Dunker, Philippi, Abb. Beschr. Conch. 3: 66, pl. 2, fig. 8.

1850. *Nassa curta* Gould, Proc. Bost. Soc. Nat. Hist. 3: 153 (Samoa I.).

1852. *Nassa curta* Gould, U.S. Expl. Exp. 12: 258, pl. 19, figs. 326a-c.

1853. *Nassa horrida* Dunker, Reeve, Conch. Icon. 8: pl. 11, figs. 69a, b.

1853. *Nassa muricata* Quoy & Gaimard, Reeve, Conch. Icon. 8: pl. 11, figs. 73a, b.

1880. *Nassa decorata* Marrat, Var. shells gen. Nassa p. 36 (Hab: ?) [*fide* Tomlin, 1940].

1886. *Nassa (Hebra) muricata* Quoy & Gaimard, Watson, Rep. Voy. H.M.S. Challenger 15: 184).

1936. *Nassarius* (?) *horridus* (Dunker), Peile, Proc. Malac. Soc. Lond. 22: 141, fig. 6 (radula).

1966. *Scabronassa horrida* (Dunker), Habe & Kosuge, Shells world col. 2: 60, pl. 22, fig. 3.

Similar to *N. echinatus* (A. Adams), 11-15mm in length, but more depressed, ovate and barrel-shaped, with about the same number of axial ribs as in *N. echinatus*. On the body whorl, the spines more regular and numerous, and composed of 6-9 rows of close-set spicules which decrease in size towards the base. Aperture more rounded, columellar callus more expanded and orbicular and prominently wrinkled along its entire length; denticles on outer lip numerous and irregular, lirae extending deep into the aperture. White, cream to light brown in colour, flecked or banded with reddish-brown or dark brown, aperture and columellar callus cream, deep interior of aperture banded with purple-brown.

TYPE LOCALITY: None. (Carteret Harbour, New Ireland – *muricatum* Quoy & Gaimard).

HABITAT: In coral and weedy sand, from the intertidal zone to a depth of 22 metres.

Material examined: Samoa: Apia harbour; Mauono I., Upolu I. 4 - 6 m; Vailele beach; lagoon off Fuailalo, Upolu I., 4 - 6 m; Suva reef, Fiji I.; Manava I., Fiji I.; New Hebrides: Port Havannah; Kakula I., Undine Bay; Malapoa Pt., Vila harbour; Pango Pt.; Tuki Tuki Pt., all Efate I.; Lifu, Loyalty I.; Pt. Pimente, Arsenal Bay, Mauritius; Mazizini, W. Zanzibar, E. Africa.

Hebra horrida is superficially similar to *Nassarius echinatus* but differs in apertural features (Figs. 87 - 89) and radular characters. (Figs. 92, 94 - 95). Both species are sympatric in several Pacific localities, particularly Tonga, Fiji and the New Hebrides. Large samples taken at 9 localities in these islands, yielded 60 specimens of *Hebra horrida* to 33 specimens of *Nassarius echinatus*, a ratio of 2:1. Watson (1886) found both species in 12 fathoms (22 metres) at Levuka, Fiji I.

Buccinum muricatum Quoy & Gaimard and *B.scabrum* Dunker, are both homonyms, and the next available synonym, i.e. *B.horridum* has been utilized for this species.

Hebra subspinosa (Lamarck, 1822) (Figs. 84 - 86, 96)

1822. *Buccinum subspinosum* Lamarck, Hist. Nat. anim. s. vert. 7: 273.

1834. *Buccinum subspinosum* Lamarck, Kiener, Spéc. gén. icon. coq. viv. 9: 94, pl. 26, fig. 103.

1876. *Nassa trinodosa* E. A. Smith, J. Linn. Soc. Lond., Zool. 12: 545, pl. 30, fig. 2.

1957. *Nassarius subspinosus* Lamarck, Kaicher, Indo-Pacific sea shells pl. 7, fig. 22.

1966. *Scabronassa subspinosa* (Lamarck), Habe & Kosuge, Shells world col. 2: 60, pl. 22, fig. 9.

Shell 11-22mm in length, solid, sculptured with prominently noduled and coarse axial ribs which number from 8-14 on the penultimate and from 7-10 on the body worl; in some specimens the nodules are large and arranged in 2-3 spiral rows on the body whorl, while in others the nodes are subdued. Prominent spiral cords override axial ribs and number from 3-10 on the penultimate and from 9-18 on the body whorl. Aperture ovate, columella calloused without being expanded, smooth in centre, and with 2, rarely up to 4, denticles anteriorly; outer lip with 6-10 denticles which extend only for a short distance into the aperture. White to bluish-grey in colour, frequently banded with dark brown; columella and edge of outer lip violet, aperture purple-brown, banded with white.

TYPE LOCALITY: None. (San Christoval, Solomon I. – *trinodosa* E. A. Smith).

HABITAT: This intertidal species is generally found on reef flats, in small pockets of sand under coral rocks, and does not live in sandy lagoons or sand-banks.

Material examined: Tuki Tuki Pt., New Hebrides; Bushmens Bay, Malekula I., New Hebrides; Pt. Hedland, W. Australia; Philippines: Cebu City, Cebu I.; Cape Santiago, Luzon I.; Masingin I., Bohol; Olangold, Cebu I.

The two syntypes of *Buccinum subspinosum* are in the Museum d'Histoire Naturelle, Geneva, No. 1102/6/1-2, length 13.3 mm and 14.0 mm (Fig. 86).

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THE TAXONOMY OF SOME INDO-PACIFIC MOLLUSCA WITH DESCRIPTIONS OF NEW SPECIES

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Abstract. A new ovulid *Primovula* from the Red Sea and a subspecies of the Miocene *Mitra sowerbyi* d'Orbigny, are described as new to science. Three species of Mitridae are re-assigned to the genera *Mitra, Subcancilla* and *Neocancilla.* An aberrant form of *Cerithium (Pseudovertagus) aluco* (Linnaeus) and a recently collected specimen of *Bursa (Colubrellina) condita* (Gmelin), are discussed and illustrated.

Through the courtesy of Dr. B. Wilson from the Western Australian Museum, Perth, the writer received all mitrid molluscs collected by the "Mariel King Memorial Moluccas Expedition 1970" for examination. Supplementary material was received from Dr. J. Knudsen, Universitetets Zoologiske Museum, Copenhagen, and Mr. V. Dan, Manila, Philippines. Examination of specimens and radula anatomy necessitates several generic re-assignments in the Mitridae, and the description of a living subspecies of *Mitra sowerbyi* d'Orbigny, believed to have been extinct since the late Miocene.

Family MITRIDAE

Genus **Mitra** Lamarck, 1798

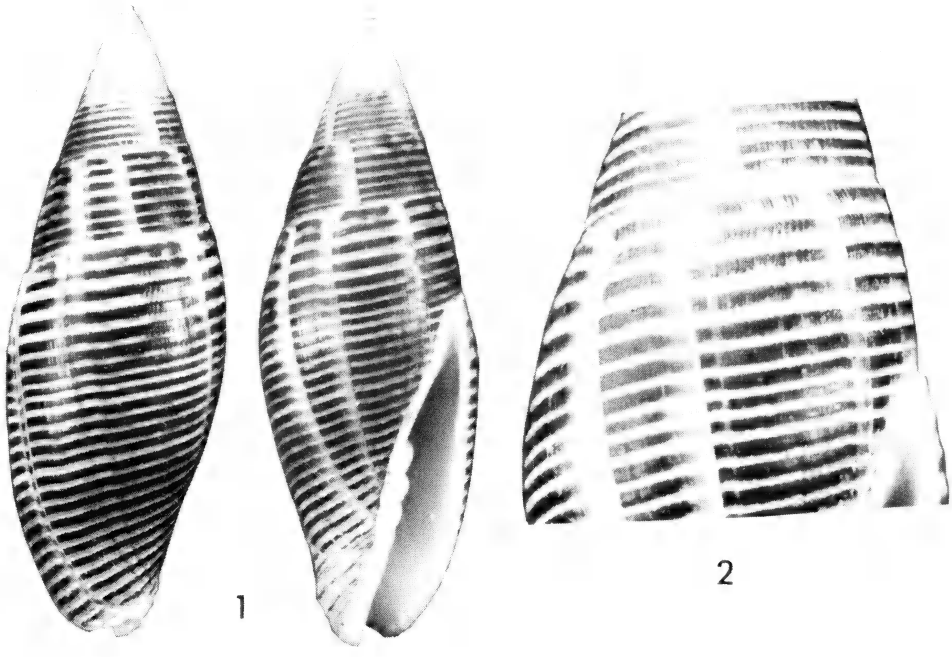
Subgenus **Nebularia** Swainson, 1840

Nebularia Swainson, 1840, Treat. Malacology, p. 130. Type species by SD (Herrmannsen, 1847) *Mitra contracta* Swainson, 1820. Recent, Indo-Pacific.

Mitra (Nebularia) sowerbyi kingae subsp. n. (Figs. 1-2,6)

Shell moderate in size, elongate-ovate and slightly cylindrical, sutures moderately impressed, teleoconch of 6½ almost flat-sided whorls, glassy-white nuclear whorls partly missing. First 2 post-nuclear whorls slightly convex, body whorl distinctly convex and slightly inflated anteriorly to the body whorl suture. Spiral sculpture consisting of fairly regular, flat and feebly elevated cords which number 7 on the spire whorls and 29 on the body whorl. Longitudinal sculpture of fine and crowded axial striae which override spiral cords and produce axial lirae and intervening pits in the narrow interspaces; longitudinal sculpture weakens below periphery of the body whorl where only crowded, small pits appear in the interspaces. Aperture longer than the spire, narrow, smooth within; outer lip elongate and convex, thickened and minutely crenulate at the margin. Columella calloused, and with 5 prominent oblique folds which decrease in size anteriorly; siphonal canal straight, siphonal notch distinct. Base colour off-white, in parts creamy-white, spiral cords dark reddish-brown, colouring interrupted in places by white longitudinal growth-marks; aperture and columella porcellaneous-white, first 2 post-nuclear whorls white.

Radula typically mitrine but extremely small, only 7.2% of shell-length. Rachidians wider than high and with 7 regular cusps, laterals about 1.6 x the width of rachidians and with 11 cusps which decrease in size towards the outer margin (Fig. 6).



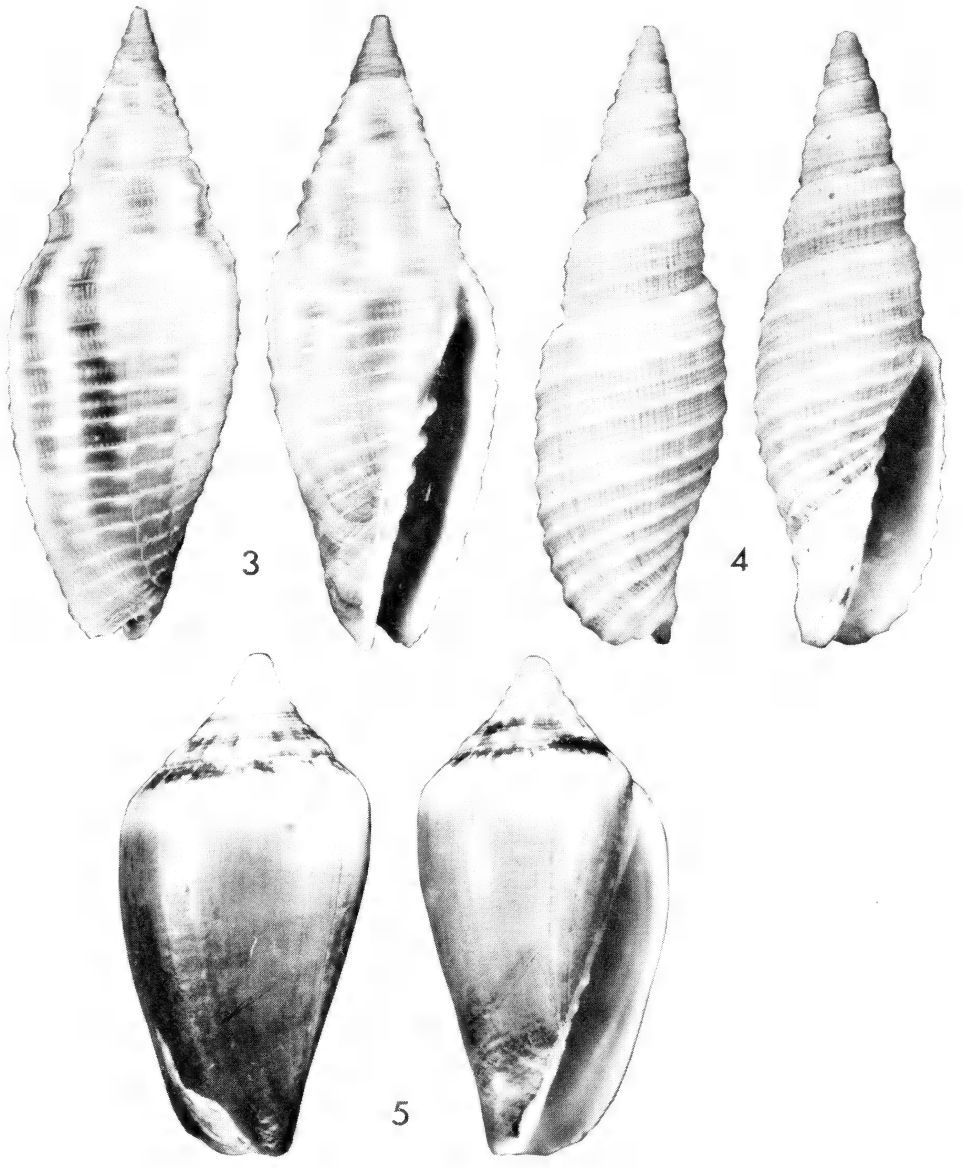
Figs. 1-2. *Mitra (Nebularia) sowerbyi kingae* subsp. n. Moluccas, Indonesia, 18-22 fathoms (33-40 metres). 1. Holotype WAM Lot No. 84 (1); length 34.6 mm. 2. Sculptural detail of holotype.

TYPE LOCALITY: Station AW-I, Haul 6, off west coast of Wasir Island, west Wokam, Aru Isds., Moluccas, Indonesia, Latitude 5°30′s, Longitude 134°12′, in 18-22 fathoms (33-40 metres), sand and shell-rubble.

Holotype: Presently lodged in the Western Australian Museum, Perth, Lot No. 84 (1); length 34.6 mm, height of aperture 19.8 mm (Figs. 1-2). Collected by the "Mariel King Memorial Moluccas Expendition 1970", 15.VI.1970. Type to be transferred to an appropriate Institution in Indonesia at a later date.

The living subspecies *kingae* differs from the Indian Miocene *Mitra sowerbyi sowerbyi* d'Orbigny, 1852, in being more slender, with a higher spire, more numerous spiral cords, broader interstices between cords, a narrower aperture and less widely spaced columellar folds. The Indonesian Miocene *M.sowerbyi sedanensis* Martin, 1906, is broader and more inflated, the whorls are convex, the sculpture is finer, the interspaces and cords are more thread-like, the aperture is wider and the columellar folds thinner and more widely spaced.

The new subspecies is named in memory of the late Mrs. M. E. King, in recognition of her extensive field contribution to Indo - Pacific malacology.



Figs. 3-5. 3. *Subcancilla flammea* (Quoy & Gaimard). Tg Lelar, Trangan, Aru I., Moluccas, 12 fathoms (22 metres); length 27.8 mm. 4. *Neocancilla circula* (Kiener). Singapore, Malaysia; length 32.6 mm. 5. *Mitra carbonacea* (Hinds). Bay of Rufisque, West Africa; length 19.7 mm.

Mitra carbonacea (Hinds, 1844) (Figs. 5, 7)

1844. *Imbricaria carbonacea* Hinds, Zool. Voy. "Sulphur", p. 41, pl. 11, figs. 9, 10; 1956, Knudsen, Atlantide Rept. No. 4: 70; 1970, Cernohorsky, Bull. Auckland Inst. Mus. No. 8: 43 (name published October 1844).

1844. *Mitra citrina* Reeve, Conch. Iconica, vol. 2, pl. 27, figs. 215a, b (name published December 1844).

1853. *Mitra rollandi* Bernardi, J. Conchyl. 4: 67, pl. 2, figs. 6, 7.

Originally described by Hinds (1844) from Agulhas Bank, Cape of Good Hope, the species has never been recorded from South African waters but has been found living in West Africa. The distribution of the species is from Mossamedes, Angola, to Port Etienne, Mauritania.

Described in the genus *Imbricaria* Schumacher, and assigned to this genus by subsequent authors on the basis of shell-morphology, a re-assignment to the genus *Mitra*, subfamily Mitrinae, is necessary on the basis of radular characters. A specimen from Gorée, Senegal (leg.G.Thorson, Zool.Mus.Copenhagen) had a typically mitrine dentition with a 7-cuspid rachidian and 19-cuspid lateral which is 2.75 x as broad as the rachidian (Fig. 7).

The syntypes of *Mitra citrina* Reeve, in the British Museum (Natural History), no.1967719, are the same species as *M.carbonacea*.

Genus **Subcancilla** Olsson & Harbison, 1953

Subcancilla Olsson & Harbison, 1953, Acad. Nat. Sci. Philadelphia Mon. No. 8: 190. Type species by OD *Mitra sulcata* Swainson in Sowerby, 1825.

Subcancilla flammea (Quoy & Gaimard, 1833)

1833. *Mitra flammea* Quoy & Gaimard, Voy. L'Astrolabe, 2: 659, pl. 45bis, figs. 23-25.

1844. *Mitra flammigera* Reeve, Conch. Iconica, vol. 2, pl. 22, figs. 173a, b.

1965. *Mitra (Cancilla) flammigera* Reeve, Cernohorsky, Veliger, 8: 105, pl. 15, fig. 30.

The species has been variously assigned to *Mitra*, *Cancilla* or *Ziba*, but the radula characters are those of *Subcancilla*. The rachidian has 5-6 long and slender cusps on a broad but low base; the laterals have 4-5 cusps, with the inward pointing cusp very large, and occasionally a small accessory denticle on the cutting edge.

The morphologically similar species from Mauritius and the Fiji Islands, figured by the writer as *M.flammea* (Cernohorsky, 1965, pl. 15, fig. 29), is the species *M.intersculpta* Sowerby, 1870. The radula of this species (Cernohorsky 1970, fig. 83) is prominently different from the radula of *Subcancilla flammea* despite the close resemblance of the two species in shell-morphology.

Genus **Neocancilla** Cernohorsky, 1966

Neocancilla Cernohorsky, 1966, Veliger, 9: 110. Type species by OD *Voluta papilio* Link, 1807.

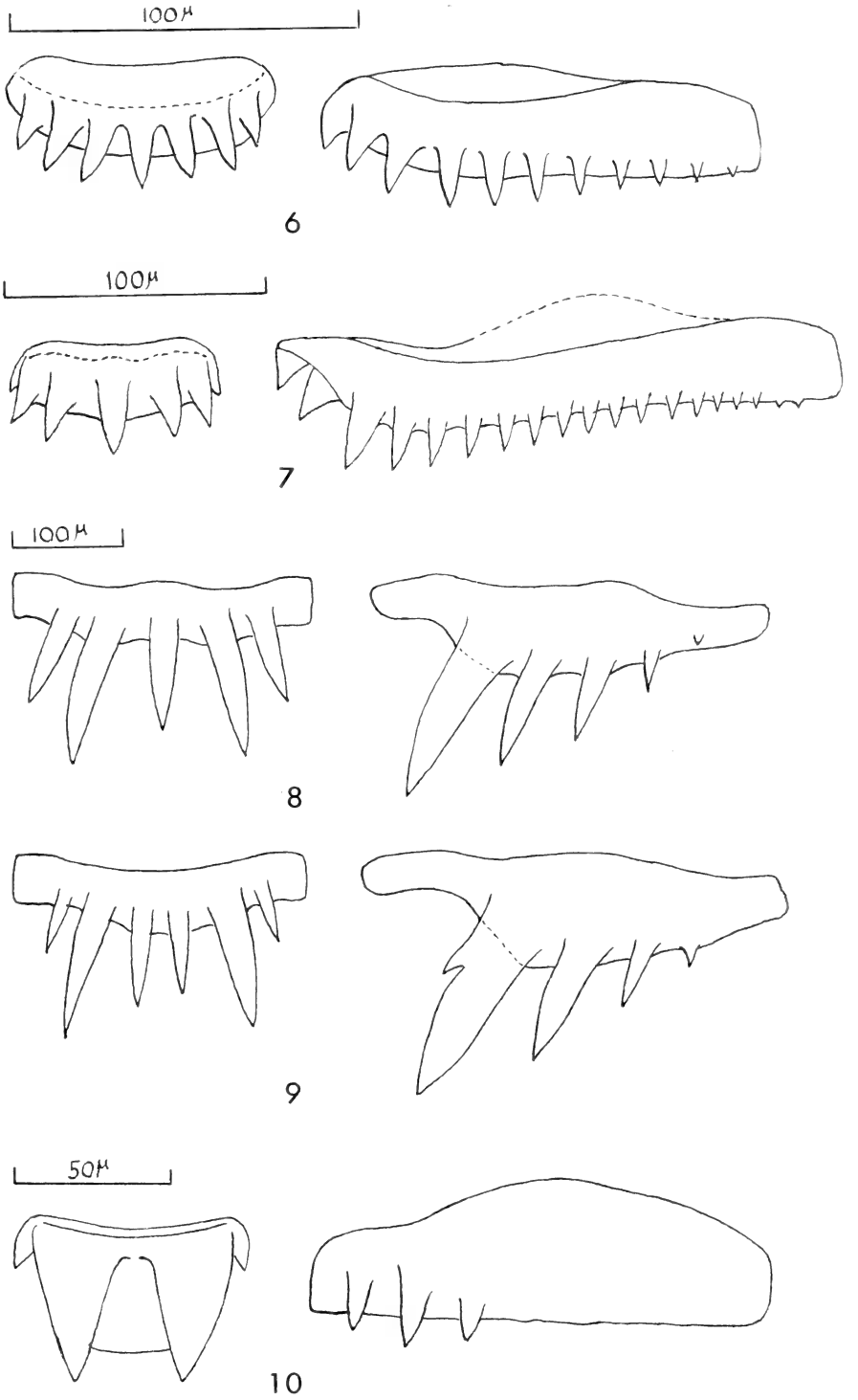
Neocancilla circula (Kiener, 1838) (Figs. 4, 10)

1838. *Mitra circula* Kiener, Spéc. gén. icon. coq. viv. 3: 21, pl. 5, fig. 13.

1844. *Mitra circulata* Reeve, Conch. Iconica, vol. 2, pl. 11, fig. 77.

1853. *Mitra rufescens* A. Adams, Proc. Zool. Soc. London, for 1851, p. 137.

1920. *Mitra burnupiana* Cooke, Proc. Zool. Soc. London, for 1819, p. 415 *(nom. nud.)* [description of radula].



Figs. 6-10. Half-row of radulae. 6. *Mitra (Nebularia) sowerbyi kingae* subsp. n. from holotype. 7. *M. carbonacea* (Hinds). Gorée, Senegal, West Africa, 16-20 metres. 8, 9. *Subcancilla flammea* (Quoy & Gaimard). Tg Lelar, Trangan, Aru I., Moluccas, 12 fathoms (22 metres). 10. *Neocancilla circula* (Kiener). Tg Lelar, Trangan, Aru I., Moluccas, 6-8 fathoms (11-15 metres).

1920. *Mitra burnupiana* Cooke, Proc. Malac. Soc. London, 14: 114, figs. 1, 2.

1965. *Mitra (Cancilla) incarnata* Reeve, Cernohorsky, Veliger, 8: 106, pl. 16, figs. 39, 39a (non Reeve, 1845).

Examination of Kiener's type-specimens of *M.circula* in the Muséum d'Histoire Naturelle, Geneva, and radulae of recently collected specimens from the Moluccas, assist in establishing the identity, synonymy and generic placement of the species. *M.circula* is characterized by the elevated but rounded spiral cords and broad interspaces which contain a net-like sculpture of compressed axial striae and overriding spiral threads. The colour is generally fawn, paling towards the sutures, but some individuals are uniformly brown, others creamy-white and banded in the centre.

The radula has rectangular rachidians with 2 large cusps and 2 minute side-cusps; the laterals are 2 x as broad as the rachidians and have only 3 cusps, plus occasionally another 2 very weak cusps, and the remainder of the tooth is bare.

Family CERITHIIDAE

Genus **Cerithium** Bruguière, 1789

Subgenus **Pseudovertagus** Vignal, 1904

Pseudovertagus Vignal 1904, Bull. Mus. d'Hist. Nat. Paris, 10: 358. Type species by M *Murex aluco* Linnaeus, 1758.

Cerithium (Pseudovertagus) aluco (Linnaeus, 1758) (Fig. 11)

1758. *Murex aluco* Linnaeus, Syst. Naturae, ed. 10, p. 755.

A most unusual and aberrant form of the species, probably pathological in origin, has recently been collected at Mainbon, Sulu, Philippines, by Mr. V. Dan. This aberrant form, which barely resembles normal individuals of the species, is greatly depressed and inflated, with a broad and flaring aperture, and lacks the usual axial ribs on the spire whorls and prominent nodulose knobs on the later whorls. The specimen has, however, retained the bi-angulate body whorl, typical colouring and apertural features, but the spiral sculpture is more prominent than in normal individuals.

Family BURSIDAE

Genus **Bursa** Röding, 1798

Subgenus **Colubrellina** Fischer, 1884

Colubrellina Fischer, 1884, Man. Conchyliologie, p. 656. Type species by M *Ranella candisata* Lamarck = *Murex conditus* Gmelin, 1791.

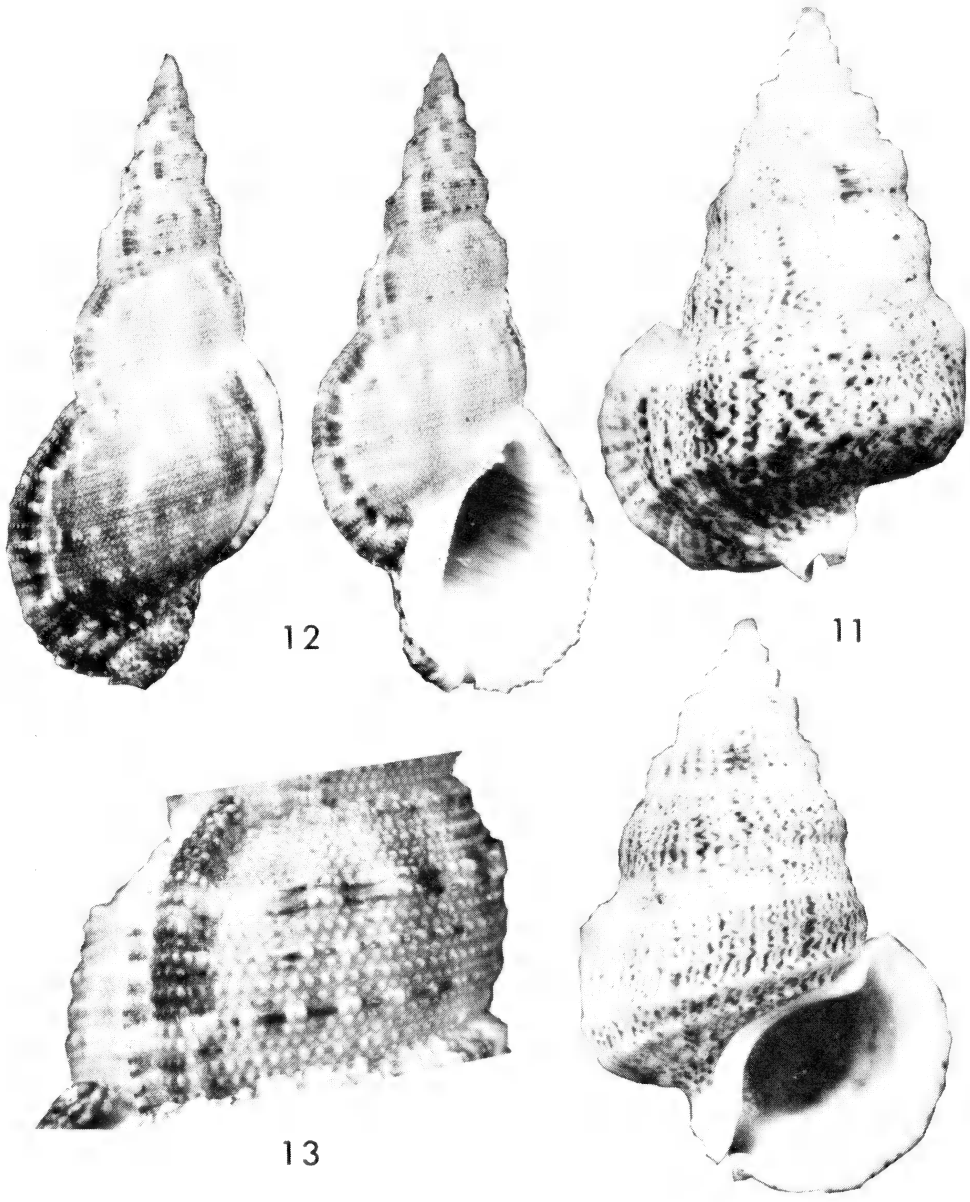
Bursa (Collubrellina) condita (Gmelin, 1791) (Figs. 12-13)

1788. *"Murex candisatus"* Chemnitz, Syst. Conch. Cabinet, 10: 254, pl. 162, figs. 1544, 1545 *(non. binom.).*

1791. *Murex conditus* Gmelin, Syst. Naturae, ed. 13, p. 3565 (refers to Chemnitz, *op. cit.*, figs. 1544, 1545).

1798. *Tritonium candisatum* Röding, Mus. Boltenianum, p. 126 (refers to Chemnitz, *op. cit.*, figs. 1544, 1545).

1817. *Colubraria granulata* Schumacher *(pars)*, Essai nouv. syst., p. 251.



Figs. 11-13. 11. *Cerithium (Pseudovertagus) aluco* (Linnaeus). Aberrant form. Mainbon, Sulu, Philippines, intertidal; length 47.3 mm. 12, 13. *Bursa (Colubrellina) condita* (Gmelin). Borongan, Eastern Samar, Philippines, intertidal; length 113.2 mm. 12. Dorsal and ventral views. 13. Sculptural detail of penultimate whorl.

This rare species which is seldom mentioned or illustrated in malacological literature, has been described from unknown locality and was subsequently reported from Tahiti and Japan. A form of this species or a geographical subspecies, was recently described as *Bursa(Colubrellina)natalensis* Coelho & Matthews, 1970, from Brazil.

The illustrated, 113.2 mm long specimen from the Philippines, has $8\frac{1}{2}$ mature, subangulate whorls and a sculpture of 21 granulose cords on the penultimate whorl and about 50 cords on the body whorl. Two of these cords, rarely one or three, are more prominent and elevated and studded with spaced nodules, which are usually arranged in groups of 4 to 6 nodules. The aperture is lirate, the outer lip has 24 denticles and the columella is wrinkled and plicate on the prominent callus-shield.

The species is generally cited as *Bursa candisata* (Lamarck, 1822), but apart from the prior *candisata* of Röding, *Murex conditus* Gmelin, has chronological priority.

Family OVULIDAE

Genus **Primovula** Thiele in Kükenthal & Krumbach, 1925

Primovula Thiele in Kükenthal & Krumbach, Handb. Zoologie, vol. 5, p. 88. Type species by OD *Amphiperas beckeri* Sowerby, 1900.

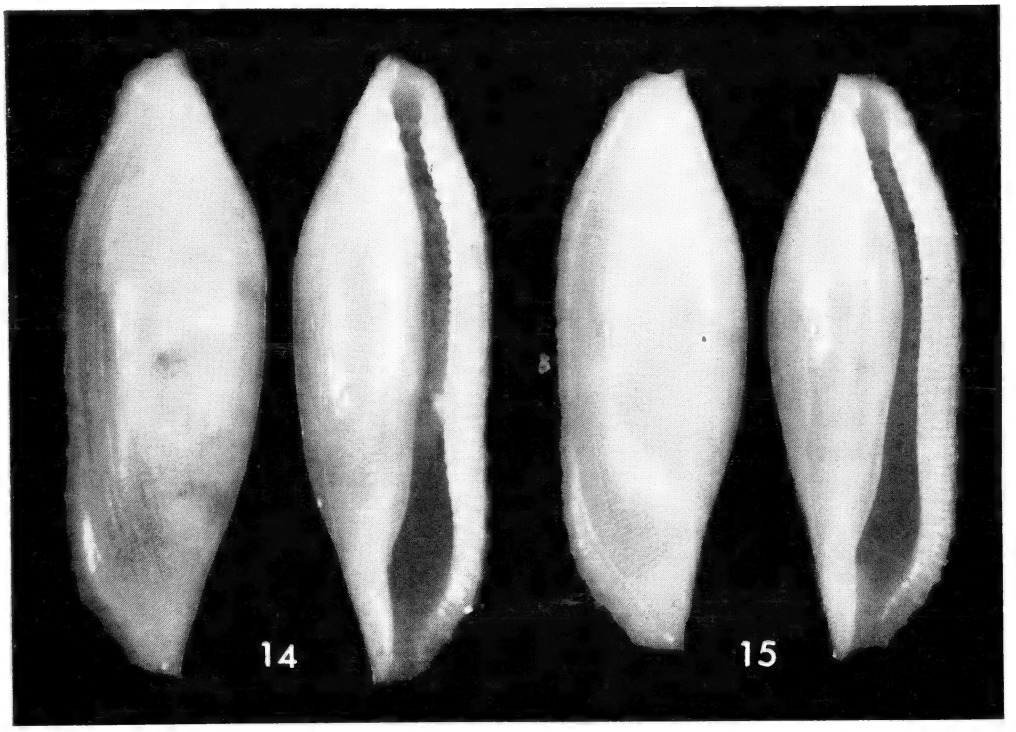
Primovula eilatensis sp.n. (Figs.14-15)

Shell very small, 10.0-11.0 mm in length, elongate-fusiform, width 29-32% of length, yellow in colour, margin of outer lip and columellar carina orange. Dorsum with numerous fine spiral striae throughout its entire length (paratype), or with the centre of the dorsum smooth and spiral striae confined to the extremities only (holotype): the posterior third of the dorsum has an obsolete transverse carina which is indicated only by a slight swelling, but varies in prominence in individuals. Outer lip bi-angulate, descending almost vertically between the angulations, and slightly constricted at the anterior third, lip moderately broad, flattened, weakly concave and angled towards the aperture in profile; the lip is toothed along its entire length, denticles irregular, often intercalate, and numbering 44 (holotype) to 58 (paratype), teeth reaching the margin of the outer lip and continue for a short distance up the margin. Aperture narrow, widening anteriorly, funiculum with 9-10 plicae, columella with a longitudinal carina which is obsoletely denticulate, denticles numbering about 30 in the holotype but are weak and uncountable in the paratype. Anterior outlet with a terminal ridge, columella smooth in the holotype but finely obliquely striate in the paratype, fossula concave, projecting and completely smooth.

TYPE LOCALITY: Eilat, Gulf of Aqaba, Israel, in 15 metres on *Clathraria rubronudosa, Suberogorgia* sp. and *Gorgonia* sp. (Prof. L. Fishelson, *in litt*).

Holotype: In the Department of Zoology, Tel-Aviv University, Tel Aviv, Israel, No NS-8899; length 11.2 mm, width 3.3 mm, (Fig. 14).

Paratype: Paratype No. 1, length 10.4 mm, width 3.3 mm.in Auckland Institute and Museum, Auckland; juvenile paratype No. 2, length 5.4 mm, in Tel Aviv University.



Figs. 14-15. *Primovula eilatensis* sp. n. Eilat, Gulf of Aqaba, 15 metres. 14. Holotype Tel-Aviv University No. NS-8899; length 11.2 mm. 15. Paratype AIM; length 10.4 mm.

Primovula eilatesis is one of the most elongate-fusiform ovuline species on record. The species resembles *P.striatula* (Sowerby, 1828), but this species is considerably broader (width 40-50% of length), less elongate-fusiform and broader at its posterior third, the teeth on the outer lip are developed only on the posterior half, become obsolete anteriorly and do not reach the margin, the aperture is narrower and does not widen anteriorly, the outer lip is not biangulate, the dorsal carina is more prominent and the speces is higher in profile.

Primovula horimasarui C. Cate, 1971, is similar in form, but has a twisted appearance, and lacks a bi-angulate outer lip which is also edentulous. *P.virgo* C Cate, 1971, is broader, the outer lip is not bi-angulate, and instead of being flat is rounded and only weakly dentate along two-thirds of its length.

Acknowledgements. I would like to thank Dr B. Wilson, Western Australian Museum, Perth, Dr J. Knudsen, Universitetets Zoologiske Museum, Copenhagen, Prof. Dr A. Barash and Prof. L. Fishelson, Tel-Aviv University, Tel Aviv, and Mr V. Dan, Manila, Philippines, for the opportunity to examine molluscan material in their respective care.

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A TAXONOMIC EVALUATION OF RECENT AND FOSSIL NON-MITRID SPECIES PROPOSED IN THE FAMILY MITRIDAE (MOLLUSCA: GASTROPODA)

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Abstract. 274 taxa originally proposed in the family Mitridae are here re-assigned to the families Strombidae (1 sp.), Fasciolariidae (16), Muricidae (1), Buccinidae (6), Columbellidae (18), Nassariidae (1), Volutidae (67), Volutomitridae (99), Olividae (1), Marginellidae (11), Cancellariidae (6), Turridae (36) and the terrestrial Oleacinidae (1). The familial status of 10 species remains undetermined.

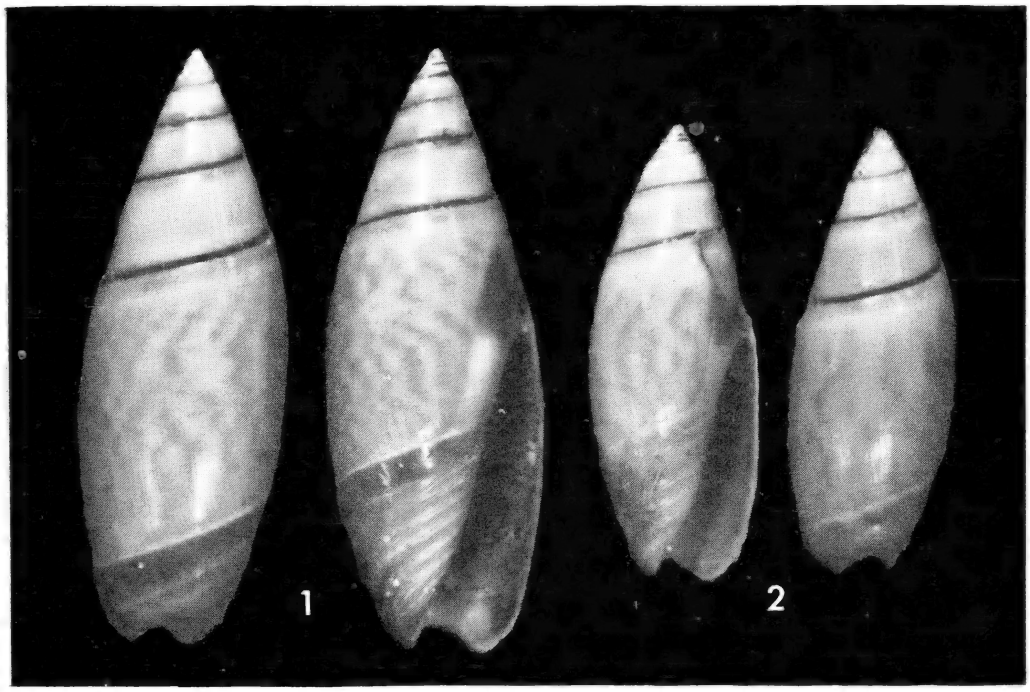
During a current revision of the gastropod family Mitridae, the examination of types, original descriptions and type figures of described species necessitated a re-assignment of 274 species to 13 other molluscan families. The location of type species, where known, is indicated, and the abbreviations for the respective Museums and Institutions are as follows:

AIM	=	Auckland Institute & Museum, Auckland, New Zealand
AMS	=	Australian Museum, Sydney, Australia
ANSP	=	Academy of Natural Sciences of Philadelphia, Philadelphia, U.S.A.
BMNH	=	British Museum (Natural History), London, England
CAS	=	California Academy of Sciences, San Francisco, U.S.A.
CM	=	Canterbury Museum, Christchurch, New Zealand
DM	=	Dominion Museum, Wellington, New Zealand
IRSN	=	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium
MHNG	=	Muséum d'Histoire Naturelle, Geneva, Switzerland
MNHNP	=	Museum National d'Histoire Naturelle, Paris, France
NZGS	=	New Zealand Geological Survey, Lower Hutt, New Zealand
OUM	=	Otago University Museum, Dunedin, New Zealand
SMF	=	Senckenberg Museum, Frankfurt a.M., Germany
UA	=	University of Auckland (Dept. of Geology), Auckland, New Zealand
USNM	=	National Museum of Natural History, Washington, U.S.A. (formerly U.S. National Museum)
ZIHU	=	Zoological Institut, Humboldt University, Berlin, Germany
ZMUC	=	Zoological Museum, University of Copenhagen, Denmark

The following list is in alphabetical order of trivial names, regardless of genera.

Mitra affinis Lesson, 1842 (Figs. 1 - 2)
Mitra affinis Lesson, 1842, Rev. Zool. Soc. Cuvier. 5: 142. Gambier I., Tuamotu Archipelago = error! Types MNHNP: 19.5 & 15.0mm.

This is a synonym of *Olivella (Lamprodoma) volutella* (Lamarck, 1811) from the west coast of central America.



Figs. 1-2. *Mitra affinis* Lesson. Syntypes MNHNP, length 19.5mm and 15.0mm respectively. Gambier I., Tuamotus = error! (= *Olivella volutella* (Lamarck), west coast of America). (Photo: Muséum National d'Histoire Naturelle, Paris).

Mitra alabamensis Tomlin, 1920
Mitra alabamensis Tomlin, 1920, Nautilus 33: 134. Claiborne, Alabama; Eocene.

Proposed as a superfluous substitute name for *Mitra elegans* Lea, 1840, the species is a synonym of *Terebrifusus amoenus* (Conrad, 1865), in the family Buccinidae.

Mitra albopicta E. A. Smith, 1898
Mitra albopicta E. A. Smith, 1898, Proc. Mal. Soc. London 3: 21, textfig. 5. Mokohinau I., New Zealand. Type NZGS No. TM-919: 21.5 x 9.5mm.

A synonym of *Waimatea obscura* (Hutton, 1873), family Volutomitridae.

Mitra alizalis Anderson & Hanna, 1925
Mitra alizalis Anderson & Hanna, 1925, Occ. Pap. Calif. Acad. Sci. 11: 76. Live Oak Creek, Tejon form., Californian; U. Eocene. Type CAS No. 361: 4.7 x 3.1mm.

A species of *Conomitra* Conrad, 1865, family Volutomitridae.

Strigatella americana Dall, 1915
Strigatella americana Dall, 1915, U.S. Nat. Mus. Bull. 90: 61, pl. 9, fig. 2. Chipola River marls, Florida; L. Miocene. Type USNM No. 114343: 28.0 x 15.0 x 20.0mm.

A species of *Enaeta* H. & A. Adams, 1853, family Volutidae, and very similar to *E. isabellae* (Maury, 1910).

Pterygia amoena Röding, 1798
Pterygia amoena Röding, 1798, Mus. Bolten. p. 51. Loc.: ?

A synonym of *Pyrene (Columbella) mercatoria* (Linnaeus, 1758), family Columbellidae.

Mitra (Terebrifusus) amoena de Gregorio, 1890
Mitra (Terebrifusus) amoena de Gregorio, 1890, Ann. Geol. Pal. Palermo 7: 76, pl. 5, fig. 61. Claiborne & Lisbon, Alabama; Eocene.

A synonym of *Terebrifusu amoenus* (Conrad, 1865), family Buccinidae, and a homonym of *Mitra amoena* A. Adams, 1853.

Pterygia ancilla Röding, 1798
Pterygia ancilla Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Adelomelon ancilla* (Lightfoot, 1786), family Volutidae.

Mitra (Conomitra) angulata Heilprin, 1887
Mitra (Conomitra) angulata Heilprin, 1887, Trans. Wagner Free Inst. Sci. Philad. 1: 110, pl. 15, fig. 47. Ballast Pt., Silex beds, Florida; Miocene.

A synonym of *Conomitra staminea* (Conrad, 1848), family Volutomitridae.

Mitra anticoronata Johnston, 1880
Mitra anticoronata Johnston, 1880, Proc. R. Soc. Tasmania p. 34. Table Cape, Tasmania; L. Miocene. 13.0 x 5.0 x 7.0mm.

Probably a member of the family Volutomitridae. The species has never been illustrated and the type is either lost or mislaid.

Mitra apicalis Hutton, 1873
Mitra apicalis Hutton, 1873, Cat. Tert. Moll. Echin. N.Z. p. 7. Awamoa, New Zealand; L. Miocene. Holotype lost.

A species of *Proximitra* Finlay, 1927, family Volutomitridae.

Vexillum apicicostatum Suter, 1917
Vexillum apicicostatum Suter, 1917, N.Z. Geol. Surv. Pal. Bull. No. 5: 27, pl. 12, fig. 5. Marly greensands, Waihao River, S. Canterbury, New Zealand; M. Eocene. Holotype NZGS 11.6 x 5.2 x 7.6mm.

A member of *Waimatea* Finlay, 1927, family Volutomitridae.

Mitra (Mitromorpha) aptycha Böttger, 1906
Mitra (Mitromorpha) aptycha Böttger, 1906, Verh. Mitt. Ver. Nat. Herrmannstadt 54: 12, Zilch, 1934, Senckenbergiana 16: pl. 18, fig. 38. Kostej, Banat; Miocene. Type SMF: 8.25 x 3.5 x 4.75mm.

The species belongs to the family Turridae.

Mitra (Cancilla) armorica Suter, 1917
Mitra (Cancilla) armorica Suter, 1917, N.Z. Geol. Surv. Pal. Bull. No. 5: 27, pl. 12, fig. 4. Blue Cliffs, S. Canterbury, New Zealand; L. Miocene. Type CM: 20.0 x 8.0mm.

A New Zealand subspecies of *Proximitra atractoides* (Tate, 1889), family Volutomitridae.

Cylindromitra asphaltodes Beets, 1943
Cylindromitra asphaltodes Beets, 1943, Leid. geol. Meded. 13: 292, pl. 29, figs. 82, 83. Waisiu, Buton I., Indonesia; U. Oligocene. 38.0mm.

A species of *Mitreola* Swainson, 1823, family Volutidae.

Mitra atractoides Tate, 1889
Mitra atractoides Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 139, pl. 4, fig. 11. Lower beds at Muddy Creek, Victoria, Australia; M. Miocene. 21.0 x 7.0 x 12.0mm.

A member of *Proximitra* Finlay, family Volutomitridae.

Mitra atypha Tate, 1889
Mitra atypha Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 138, pl. 4, fig. 6. Upper beds at Muddy Creek, Victoria, Australia; Pliocene. 10.0 x 4.5 x 5.5mm.

This species belongs to the family Volutomitridae.

Mitra (Turris?) bairdii Dall, 1889
Mitra (Turris?) bairdii Dall, 1889, Bull. Mus. Comp. Zool. Harvard 18: 161; Bull. U.S. Nat. Mus. No. 37: 110, 189, pl. 42, fig. 7. 100 miles S.E. by S. from Cape Fear, N. Carolina, 528 fathoms. Type USNM No. 86962: 34.2 x 8.6 x 11.6mm.

The species has been tentatively assigned to the family Volutomitridae.

Mitra (Mitreola) bernayi Cosmann, 1889
Mitra (Mitreola) bernayi Cossmann, 1889, Ann. Soc. R. Malac. Belg. 4: 186, pl. 7, fig. 2. Vaudancourt, Paris Basin; Eocene. 18.0 x 8.0mm.

The species is a *Mitreola* Swainson, family Volutidae.

Mitra berthelini Cossmann, 1897
Mitra berthelini Cossmann, 1897, Bull. Soc. Sci. Nat. d'Ouest 6: 238, pl. 9, figs. 16, 17. La Close, Basin de Campbon, France; Eocene. 5.0 x 2.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra biconica Whitfield, 1865
Mitra biconica Whitfield, 1865, Amer. Jour. Conch. 1: 263; Powell, 1966, Bull. Auckland Inst. Mus. No. 5: 59. Prairie Bluff, Alabama; Eocene.

A species of *Cordieria* Roualt, 1848, family Turridae.

Vulpecula (Pusia) biconica Murdoch & Suter, 1906
Vulpecula (Pusia) biconica Murdoch & Suter, 1906, Trans. Proc. N.Z. Inst. 38: 289, pl. 23, fig. 22. Off Cuvier I., New Zealand, 37 fathoms. Type DM: 5.0 x 2.8 x 2.5mm.

A species of *Microvoluta* Angas, 1877, family Volutomitridae.

Mitra biconica Sykes, 1911
Mitra biconica Sykes, 1911, Proc. Mal. Soc. London 9: 334, textfig.; 1912, Proc. Mal. Soc. London 12: 4. Mediterranean. Types BMNH No. 1885.11.5.3570: 8.2 x 3.0 x 4.3mm; 8.4mm; 8.2mm.

A synonym of *Aphanitoma locardi* Bavay, 1906, family Turridae, and a homonym of *Mitra biconica* Whitfield, 1865.

Mitra bicornis Laws, 1936
Mitra bicornis Laws, 1936, Trans. Proc. R. Soc. N.Z. 66: 113, pl. 16, fig. 66. Kaawa Creek, New Zealand; L. Pliocene. Type UA: 10.0 x 4.5mm.

The species belongs to the genus *Peculator* Iredale, 1924, family Volutomitridae.

Mitra biplicata Philippi, 1847
Mitra biplicata Philippi, 1847, Palaeontographica 1: 77, pl. 10a, figs. 16a, b. Germany: Oligocene.

A synonym of *Cordieria delucii* (Nyst, 1836), family Turridae, and a homonym of *Mitra biplicata* Risso, 1826. Philippi's taxon preoccupies the European Eocene *Cordieria biplicata* (Sowerby, 1850).

Mitra biplicata Hanley in Wood, 1856
Mitra biplicata Hanley in Wood, 1856, Ind. Testac. ed. 2, p. 106, pl. 21, fig. 27. Loc.: ?

A new combination for *Pyrene biplicata* (Gmelin, 1791), family Columbellidae, and a homonym of *Mitra biplicata* Risso, 1826.

Mitra bolaris Conrad, 1833
Mitra bolaris Conrad, 1833, Foss. shells Tert. form. N. Amer. 1: 34. Claiborne, Alabama; Eocene. Lectotype ANSP No. 14262.

A species of *Caricella* Conrad, 1835, family Volutidae.

Mitra (Mitreola) bonetti Cossmann 1901
Mitra (Mitreola) bonneti Cossmann, 1901, Ann. Soc. R. Mal. Belg. 36: 57, pl. 7, fig. 3. Chaumont, Paris Basin; Eocene. 32.0 x 10.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Strigatella (Mitreola) brachyspira Cossmann & Pissaro, 1901
Strigatella (Mitreola) brachyspira Cossmann & Pissarro, 1901, Bull. Soc. géol. Normandie 20: 90, pl. 10, fig. 18. Hauteville, Cotentin; Eocene. 19.0 x 8.5mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra brocchii de Serres, 1829
Mitra brocchii de Serres, 1829, Geog. Terr. Tert. p. 125. Les marnes argileuses bleus, Midi, Italy.

This is a synonym of *Mitrella turgidula* (Brocchi, 1814), family Columbellidae.

Mitra calcarata Sasso, 1827
Mitra calcarata Sasso, 1827, Giorn. Ligust. Sci. Genova 1: 481 (ref. to Brocchi, 1814, pl. 3, fig. 7). Basin of Albenga, Italy; Mio/Pliocene.

The species is referable to the family Cancellariidae.

Mitra carolinensis Conrad, 1841
Mitra carolinensis Conrad, 1841, Amer. Journ. Sci. Arts 41: 345, pl. 2, fig. 5. Duplin County, N. Carolina; Miocene. Paratype ANSP No. 1618: 73.0 x 24.0mm.

A new combination for *Voluta carolinensis* Conrad, 1840, which is a *Pleioptygma* Conrad, 1863, family Volutidae.

Mitra cassida Tate, 1889
Mitra cassida Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 144, pl. 6, fig. 5. Upper beds at Muddy Creek, Victoria, Australia; Pliocene. 7.0 x 4.0 x 5.5mm.

A species of *Peculator* Iredale, family Volutomitridae.

Mitra (Mitreola) chaussyenis Cossmann, 1906
Mitra (Mitreola) chaussyensis Cossmann, 1906, Ann. Soc. R. Mal. Belg. 41: 268, pl. 10, fig. 202-23. Chaussy, Paris Basin; Eocene. 68.0 x 25.0mm.

The species appears to be a *Lapparia* Conrad, 1855, family Volutidae.

Mitra circumfossa Beyrich, 1854
Mitra circumfossa Beyrich, 1854, Zeit. deut. geol. Gesell. 6: 413, pl. 8, figs. 6a, b. Westeregeln, Magdeburg, Germany; L. Oligocene. 16.0 x 6.7mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra citharella Lamarck, 1803
Mitra citharella Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 60. Grignon, Paris Basin; Eocene.

The original description of the series was based on an immature specimen of *Mitreola raricosta* (Lamarck, 1803), family Volutidae.

Mitra citharella d'Orbigny, 1850
Mitra citharella d'Orbigny, 1850, Prodr. Pal. Strat. Univ. 2: 353. Parnes & Mouchy, Paris Basin; Eocene.

Proposed as a substitute name for the non mitrid *Auricula citharella* Deshayes, 1835, the name is a homonym of *Mitra citharella* Lamarck, 1803.

Mitra citharelloides Tate, 1889
Mitra citharelloides Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 143, pl. 5, fig. 11. Blanche Pt., Aldinga Bay, Sth. Australia; Miocene. 9.5 x 3.5 x 5.0mm.

Darragh (1970) placed this species in the vexilline mitrid genus *Austromitra* Finlay, 1927. The species, however, has only 2 columellar folds which are placed centrally on the columella, a definite siphonal spout and an unnotched and slightly reverted siphonal canal. The species closely resembles New Zealand species of *Vexithara* Finlay, 1926, and would be more appropriately placed in the subfamily Mitromorphinae, family Turridae.

Mitra claibornensis Conrad, 1860
Mitra claibornensis Conrad, 1860, J. Acad. Nat. Sci. Philad. 4: pl. 47, fig. 6. Claiborne Bluff, Alabama; M. Miocene.

A synonym of *Lapparia pactilis* (Conrad, 1833), family Volutidae.

Mitra clandestina Reeve, 1845
Mitra clandestina Reeve, 1845, Conch. Icon. pl. 32, sp. 263. Loc.: ?

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835), family Turridae.

Mitra clathrata Reuss, 1845
Mitra clathrata Reuss, 1845, Verst. Boehm. Kreidef. pt. 1: 44, pl. 11, fig. 13, Moronitz, Bohemia, Czechoslovakia; U. Cretaceous.

The species is not a mitrid and may possibly be a fasciolarid. The name is a homonym of *Mitra clathrata* Defrance in Blainville, 1824.

Mitra clathurella Tate, 1889
Mitra clathurella Tate, 1889, Trans. R. Soc. Sth. Austr. 11: 142, pl. 8, fig. 8. Lower beds at Muddy Creek, Victoria, Australia; M. Miocene. 6.0 x 2.75 x 4.0mm.

A species of the genus *Proximitra* Finlay, 1927, subgenus *Parvimitra* Finlay, 1930, family Volutomitridae.

Mitra coarctata Tenison-Wood, 1880
Mitra coarctata Tenison-Woods, 1880, Proc. Linn. Soc. N.S.W. 4: 8, pl. 2, fig. 10. Muddy Creek, Victoria, Australia; Tertiary. 7.0 x 2.66mm.

A synonym of *Marginella winteri* Tate, 1878, family Marginellidae, and a homonym of *Mitra coarctata* Reeve, 1844.

Uromitra cognatella Toldo, 1889
Uromitra cognatella Toldo, 1889, Bull. Soc. Mal. Ital. 14: 147, pl. 3, fig. 8. Montegibio, Italy; U. Miocene. 6.0 x 2.6mm.

A species of *Microvoluta* Angas, family Volutomitridae.

Mitra columbellaria Scacchi, 1837
Mitra columbellaria Scacchi, 1837, Cat. Conch. reg. Neapol. p. 10, figs. 12, 13. Bay of Naples and fossil on the island of Inarimes.

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835), family Turridae.

Mitra columbellata Grateloup, 1847
Mitra columbellata Grateloup, 1847, Conch. foss. terr. Tert. Adour, Atlas, pl. 1, fig. 23. Dax, France; Miocene.

A synonym of *Mitrella turgidula* (Brocchi, 1814), family Columbellidae.

Mitra columbellina A. Adams, 1853
Mitra columbellina A. Adams, Proc. Zool. Soc. London pt. 19: 141. Loc.: ?; *Mitra columbellaria* (sic) Sowerby, 1874, Thes. Conchyl. 4: 19, pl. 28, fig. 660.

The type could not be located in the British Museum (Nat. Hist) and is presumably lost. The specimen (? type) figured by Sowerby (1874) is a species of Columbellidae.

Mitra columbelloides Anton, 1839
Mitra columbelloides Anton, 1839, Verz. Conchyl. p. 69. Paris Basin; Eocene.

A species of *Mitreola* Swainson, family Volutidae.

Mitra columbulae Brusina, 1865
Mitra columbulae Brusina, 1865, Verh. zool.-bot. Gesell. Wien 15: 14. Ragusa, Dalmatia.

The species belongs to the family Columbellidae.

Mitra complanata Tate, 1889
Mitra complanata Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 138, pl. 5, fig. 12. Adelaide Bore, Sth. Australia; Pliocene. 8.0 x 3.5 x 5.0mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Mitra concinna Beyrich, 1854
Mitra concinna Beyrich, 1854, Zeit. geol. Gesell. 6: 415, pl. 8, figs. 9a, b. Osterweddingen, Magdeburg, Germany; L. Oligocene. 8.0-9.0 x 3.5 x 4.0mm.

A species of *Conomitra* Conrad, family Volutomitridae, and a synonym of *Mitra concinna* Reeve, 1844.

Mitra conoidalis Tate, 1889
Mitra conoidalis Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 144, pl. 10, figs. 2a, b. Lower beds at Muddy Creek, Victoria; M. Miocene. 7.0 x 3.5 x 5.5mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Mitra conuliformis Cossmann, 1897
Mitra conuliformis Cossmann, 1897, Bull. Soc. Sci. nat. L'Ouest 6: 240, pl. 9, figs. 13, 14. Campbon, France; Eocene. 22.0 x 10.5 x 13.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra corrugata Defrance in Blainville, 1824
Mitra corrugata Defrance in Blainville, 1824, Dict. Sci. Nat. 31: 493. Hauteville, France; Eocene.

A synonym of *Conomitra lennieri* (Cossmann & Pissarro, 1901), family Volutomitridae, and a homonym of *Mitra corrugata* Lamarck, 1811.

Mitra costulata Risso, 1826
Mitra costulata Risso, 1826, Hist. nat. L'Europe mérid. 4: 246, pl. 10, fig. 140. Mediterranean. 16.0mm.

A species of *Mitrella* Risso, 1826, family Columbellidae.

Mitra cotteaui Cossmann & Lambert, 1884
Mitra cotteaui Cossmann & Lambert, 1884, Mém. Soc. géol. France ser. 3, 3: 180, pl. 6, figs. 13a, b. Pierrefit, Etampes, Paris Basin; Oligocene.

A species of *Conomitra* Conrad, family Volutomitridae.

Pterygia crassa Röding, 1798
Pterygia crassa Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Marginella persicula* (Linnaeus, 1758), family Marginellidae.

Mitra crassidens Deshayes, 1835
Mitra crassidens Deshayes, 1835, Desc. coq. foss. env. Paris 2: 676, pl. 90, figs. 3, 4, 7, 8. Grignon, Mouchy, Paris Basin; Eocene. 25.0mm.

A species of *Mitreola* Swainson, family Volutidae, and a homonym of *Mitra crassidens* Broderip & Sowerby, 1829.

Mitra crymochara Rochebrune & Mabille, 1885
Mitra crymochara Rochebrune & Mabille, 1885, Bull. Soc. Phil. Paris 9: 102; 1889, Miss. scient. Cap Horn 6: 49, pl. 3, figs. 1a, b. Cap Horn, Sth. America.

A species of *Volutomitra* H. & A. Adams, 1853, subgenus *Paradmete* Strebel, 1908, family Volutomitridae.

Mitra cryptodon Fischer, 1882
Mitra cryptodon Fischer, 1882, Journ. Conchyl. 30: 273. Atlantic, 1900 metres. 31.0 x 10.0 x 15.0mm.

This is a prior name for *Latiromitra specialis* Locard, 1897, and is the type species of *Latiromitra* Locard, 1897, a subgenus of *Volutomitra* H. & A. Adams, family Volutomitridae.

Fusimitra danensis Cossmann, 1899
Fusimitra danensis Cossmann, 1899, Ess. paléoc. comp. 3: 168. Denmark, Paleocene.

Proposed as a substitute name for *Mitra semilaevis* Koenen, 1885 (non Edwards, 1856), the species belongs to *Conomitra* Conrad, family Volutomitridae.

Turricula (Fusimitra) danica Ravn, 1939
Turricula (Fusimitra) danica Ravn, 1939, Biol. Skr. K. Dansk. Vid. Selsk. 1: 82. Denmark; Paleocene.

Proposed as a substitute name for *Mitra semilaevis* Koenen, 1885, the species is a synonym of *Conomitra danensis* (Cossmann, 1899), family Volutomitridae.

Mitra daphnelloides Tenison-Woods, 1880
Mitra daphnelloides Tenison-Woods, 1880, Proc. Linn. Soc. N.S.W. 4: 7, pl. 2, fig. 3. Muddy Creek, Victoria; Miocene. 6.5 x 3.0mm.

A species of *Mitrithara* Hedley, 1922, family Turridae.

Mitra decussata Dujardin, 1837
Mitra decussata Dujardin, 1837, Mém. Soc. géol. France 2: 301, pl. 20, fig. 13. Faluns de la Touraine, France; Miocene.

A species of *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, 1883, family Turridae.

Mitra delheidi Glibert, 1957
Mitra delheidi Glibert, 1957, Mem. Inst. R. Sci. Nat. Belg. No. 137: 72, pl. 6, fig. 1a only. Hemixem, Argile de Boom, Belgium; Oligocene.

The original proposal of *M. delheidi* by Vincent (1889, Ann. Soc. R. Mal. Belg. 23) is a *nomen nudum*. The species is a synonym of *Conomitra soellingensis* (Speyer, 1864), family Volutomitridae.

Vexillum desglandi Roualt, 1850
Vexillum desglandi Roualt, 1850, Bull. Soc. géol. France 7: 735.

The species does not belong in the Mitridae.

Mitra dewalquei Briart & Cornet, 1871
Mitra dewalquei Briart & Cornet, 1871, Mem. Acad. R. Sci. Lett. Art. Belg. 36: 72. Mons, Belgium; Paleocene. 21.0 x 7.5mm.

The species belongs in the family Volutomitridae.

Mitra diasticta Cossmann, 1897
Mitra diasticta Cossmann, 1897, Bull. Soc. Sci. nat. L'Ouest 6: 243, pl. 8, figs. 34, 35. Bois Gouet, Loire Inferieure; Eocene. 5.0 x 2.0 x 2.5mm.

The species belongs in the family Volutomitridae.

Mitra distorta Philippi, 1887
Mitra distorta Philippi, 1887, Tert. Quart. Verst. Chiles p. 72, pl. 8, fig. 8. Lebu, Chile; L. Pliocene. 22.0 x 10.0mm.

The species is a member of the family Fasciolariidae.

Mitra doliata Conrad, 1833
Mitra doliata Conrad, 1833, Foss. shells Tert. form. N. America 1: 34. Claiborne, Alabama; Eocene. Lectotype ANSP No. 14264.

A species of *Caricella* Conrad, family Volutidae.

Mitra douglasensis Turner, 1938
Mitra douglasensis Turner, 1938, Geol. Soc. Amer. Pap. No. 10: 74, pl. 15, fig. 6. Umpqua River, W. Oregon; Eocene. 12.6 x 7.0mm.

This is a questionable mitrid species which may possibly belong to the family Fasciolariidae.

Mitra dubia Hutton, 1873
Mitra dubia Hutton, 1873, Cat. Tert. Moll. Echin. New Zealand p. 8. Broken River, Chatham I., New Zealand; U. Oligocene.

The species belongs to the family Marginellidae.

Mitra dubia de Gregorio, 1890
Mitra dubia de Gregorio, 1890, Ann. geol. paleont. Palermo 7: 75, pl. 5, figs. 49, 56-60. Claiborne, Alabama; Eocene.

A new combination for *Voluta dubia* H. C. Lea, 1840 = *Lapparia pactilis* (Conrad, 1833), and a homonym of *Mitra dubia* Hutton, 1873.

Mitra dumasi Cossmann, 1897
Mitra dumasi Cossmann, 1897, Bull. Soc. Sci. nat. L'Ouest 6: 237, pl. 9, figs. 4, 5. Bois Gouet, Loire Inferieure; Eocene. 35.0 x 16.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra dumosa Conrad in Wailes, 1854
Mitra dumosa Conrad in Wailes, 1854, Rept. Agric. Geol. Mississippi p. 289, pl.15, fig. 4. Moody's Branch, Jackson form., Mississippi; Eocene. Holotype ANSP No. 13575.

A species of *Lapparia* Conrad, family Volutidae.

Mitra eburnea Grateloup, 1834
Mitra eburnea Grateloup, 1834, Act. Soc. Linn. Bordeaux 6: 29 (Ref. to Lamarck, 1823, Rec. planch. coq. foss. env. Paris, pl. 2, fig. 9). Dax, Cozordite, France; Miocene.

This is a new combination for *Marginella eburnea* Lamarck, 1803, family Marginellidae.

Pterygia effossa Röding, 1798
Pterygia effossa Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Eucithara subterranea* (Röding, 1798), family Turridae.

Mitra elegans H. C. Lea, 1840
Mitra elegans H. C. Lea, 1840, Amer. Jour. Sci. Arts 40: 102, pl. 1, fig. 22. Claiborne, Alabama; Eocene. 0.5 x 0.2 inches.

A synonym of *Terebrifusus amoenus* (Conrad, 1833), family Buccinidae.

Mitra enysi Hutton, 1873
Mitra enysi Hutton, 1873, Cat. Tert. Moll. Echin. N.Z., p. 7. Broken River, New Zealand; U. Oligocene. Type NZGS: 19.7 x 8.4 x 12.3mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Pterygia erminea Röding, 1798
Pterygia erminea Röding, 1798, Mus. Bolten., p. 51, Loc.: ?

A synonym of *Marginella faba* (Linnaeus, 1758), family Marginellidae.

Mitra (Volutomitra) exigua von Maltzan, 1884
Mitra (Volutomitra) exigua von Maltzan, 1884, Nachr. Deut. Malak. Gesell., 16: 72. Gorée, Senegambia, W. Africa. Type ZIHU: 6.6. x 2.6 x 3.6mm.

According to Knudsen (1956) who examined the type specimen, the species is similar to *Mitra monodi* Knudsen, 1956. This species is not a mitrid but a member of *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, family Turridae. The specific name is a homonym of *Mitra exigua* C. B. Adams, 1845.

Mitra extensa Koenen, 1890
Mitra extensa Koenen, 1890, Abh. k. preuss. geol. Land. 10: 538, pl. 38, figs. 7a, b, c. Lattorf, Germany; L. Oligocene. 5.4 x 2.1mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Vexillum fenestratum Suter, 1917
Vexillum fenestratum Suter, 1917, N.Z. Geol. Surv. Pal. Bull. No. 5, 28, pl. 4, fig. 8. Pukeuri, near Oamaru, New Zealand; L. Miocene. Type OUM: 8.0 x 3.2mm.

The familial status of the species is uncertain, but it belongs to the genus *Egestas* Finlay, 1927, which has affinities with the Fasciolariidae.

Mitra flaccida Yokoyama, 1928
Mitra flaccida Yokoyama, 1928, J. Fac. Sci. Imp. Univ. Tokyo 2: 344, pl. 67, fig. 1. Koünji and Uwaé, Hyuga Pref., Japan; Pliocene.

According to Hatai & Nisiyama (1952), this species belongs in the family Marginellidae.

Mitra flemingii Lea, 1833
Mitra flemingii Lea, 1833, Contrib. Geology p. 170, pl. 6, fig. 177. Claiborne, Alabama; Eocene.

A synonym of *Caricella bolaris* (Conrad, 1833), family Volutidae.

Vexillum fractum Marwick, 1926
Vexillum fractum Marwick, 1926, Trans. Proc. N.Z. Inst. 56: 321, pl. 73, fig. 12. Mimi Stream, New Zealand; U. Miocene. Type NZGS: 6.0 x 3.0mm.

A very juvenile specimen of Volutomitridae.

Pterygia fulgura Röding, 1798
Pterygia fulgura Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Fulgoraria rupestris* (Gmelin, 1791), family Volutidae.

Mitra columbellaria var. **fulva** Brusina, 1870
Mitra columbellaria var. *fulva* Brusina, 1870, Rad. Yugosl. Akad. 11: 58. Sottomarina and Brondolo, Gulf of Venice.

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835), family Turridae, and a homonym of *Mitra fulva* Swainson, 1829.

Mitra fusellina Lamarck, 1803
Mitra fusellina Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 59. Grignon, Paris Basin; Eocene. 4-5mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra fusoides Lea, 1833
Mitra fusoides Lea, 1833, Contrib. Geology, p. 169, pl. 6, fig. 176. Claiborne, Alabama; Eocene. Type ANSP: No. 5868: 10.5 x 5.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Turricula genotiaeformis Cossmann, 1896
Turricula genotiaeformis Cossmann, 1896, Bull. Soc. Sci. nat. L'Ouest 6 (4): 245, pl. 9, figs. 27, 28. La Close, Loire Inferieure, France; Eocene. 19.0 x 7.5 x 11.0mm.

A species of *Proximitra* Finlay, 1927, family Volutomitridae.

Mitra georgiana Conrad, 1850
Mitra georgiana Conrad, 1850, J. Acad. Nat. Sci. Philad. ser. 2, 2: 39, pl. 1, fig. 4. Georgia, S.E. United States; Eocene.

A synonym of *Lapparia pactilis*, (Conrad, 1833), family Volutidae.

Mitra gervillii Payraudeau, 1826
Mitra gervillii Payraudeau, 1826, Cat. Anell. Moll. Corse p. 165, pl. 8, fig. 21. Ventilegne and Santa Manza, Corsica.

A synonym of *Mitrella scripta* (Linnaeus, 1767), family Columbellidae.

Pterygia glabella Röding, 1798
Pterygia glabella Röding, 1798, Mus. Bolten. p. 51. Loc.: ?

A new combination for *Marginella glabella* (Linnaeus, 1758), family Marginellidae.

Mitra godini Cossmann, 1891
Mitra godini Cossmann, 1891, Ann. Soc. R. Malac. Belg. 26: 71, pl. 3, fig. 17. Parnes, Paris Paris Basin; Eocene. 4-5mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra gracilis H. C. Lea, 1840
Mitra gracilis H. C. Lea, 1840, Amer. J. Sci. Arts 40: 101, pl. 1, fig. 20. Claiborne, Alabama; Eocene. 6.0 x 2.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra grammatula Dall, 1927
Mitra grammatula Dall, 1927, Proc. U.S. Nat. Mus. 70 (18): 50. Off Georgia, S.E. United States. Type USNM No. 333456.

The species should be referred to the subfamily Mitromorphinae, family Turridae.

Mitra graniformis Lamarck, 1803
Mitra graniformis Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 59. Parnes, near Magny, Paris Basin; Eocene. 4-5mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra granulifera Lamarck, 1811
Mitra granulifera Lamarck, 1811, Ann. Mus. d'Hist. Nat. Paris 17: 221. L'Ocean des grandes Indes = error! Types MHNG No. 1102/83.

The species is very similar to the Caribbean *Morula nodulosa* (C. B. Adams, 1845), family Muricidae.

Mitra groenlandica Beck in Möller, 1842
Mitra groenlandica Beck in Möller, 1842, Naturh. Tidsskrif. 4: 88. Greenland. Types BMNH No. 43.6.30.185-189.

This is the type species of *Volutomitra* H. & A. Adams, 1853, family Volutomitridae.

Mitra haleanus Whitfield, 1865
Mitra haleanus Whitfield, 1865, Amer. J. Conch. 1 (3): 263, pl. 27, fig. 6. Vicksburg, Mississippi; Oligocene.

A species of *Athleta* Conrad, 1853, family Volutidae.

Vexillum halli Roualt, 1850
Vexillum halli Roualt, 1850, Bull. Soc. géol. France 7: 735.
The species is non mitrid.

Mitra hammakeri Harris, 1894
Mitra hammakeri Harris, 1894, Ann. Rept. Geol. Surv. Arkansas 2: 163, pl. 6, fig. 4. Lee Hammaker's well, Jackson form., Arkansas; Eocene. Type USNM No. 135132: 11.0 x 5.0mm.

This is the smooth form or subspecies of *Conomitra fusoides* (Lea, 1833), family Volutomitridae.

Mitra haycocki Dall & Bartsch, 1911
Mitra haycocki Dall & Bartsch, 1911, Proc. U.S. Nat. Mus. 40: 277, pl. 35, fig. 7. Bermuda, Caribbean. Type USNM No. 221617: 4.5 x 2.2 x 2.6mm.

The species should be referred to the subfamily Mitromorphinae, family Turridae.

Vulpecula (Pusia) hedleyi Murdoch, 1905
Vulpecula (Pusia) hedleyi Murdoch, 1905, Trans. Proc. N.Z. Inst. 37: 228, pl. 8, fig. 21. Whangarei Heads, New Zealand. Type DM No. M-1737: 5.3 x 2.7 x 3.6mm.

A species of *Peculator* Iredale, 1924, family Volutomitridae.

Mitra (Pleioptygma) heilprini Cossmann, 1899
Mitra (Pleioptygma) heilprini Cossmann, 1899, Rev. Crit. Paléoz. 3: 144. Caloosahatchie, Florida; Pliocene.

Proposed as a substitute name for *Mitra lineolata* Heilprin, 1887 (non Bellardi, 1887), the species is either a form or subspecies of *Pleioptygma carolinensis* (Conrad, 1840), family Volutidae.

Turricula hemiconoides Cossmann, 1897
Turricula hemiconoides Cossmann, 1897, Bull. Soc. Sci nat L'Ouest 8 (1): 45, pl. 2, figs. 15, 16. Coislin, France; Eocene. 12.5 x 6.0mm.

A juvenile species of *Conomitra* Conrad, family Volutomitridae.

Mitra hondana Yokoyama, 1922 (Fig. 3)
Mitra hondana Yokoyama, 1922, J. Coll. Sci. Imp. Univ. Tokyo 44 (1), 50, pl. 2, fig. 8. Shito, U. Musashino form., Japan; Plio-Pleistocene. 10.0 x 4.2mm.

A species of *Microvoluta* Angas, family Volutomitridae.

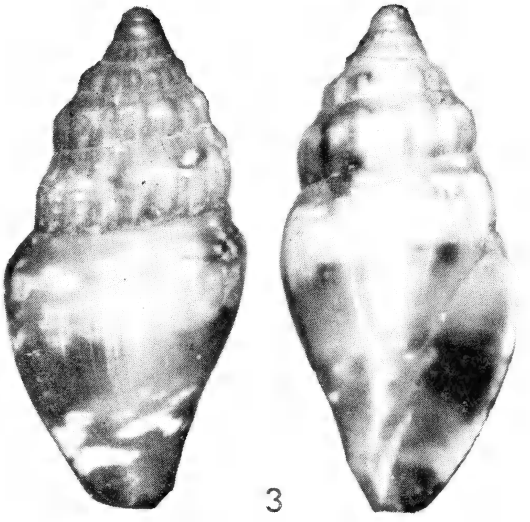


Fig. 3. *Microvoluta hondana* (Yokoyama). Jogashima, Sagami Bay, Honshu, Japan, 80-90 metres. Length 8.4mm.

Mitra hordeola Deshayes, 1865
Mitra hordeola Deshayes, 1865, Desc. Anim. sans vert. Bass. Paris 3: 576, pl. 103, figs. 17-19. Laon, Cuise, Mercin, Paris Basin; Eocene. 9.0 x 3.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Turricula hottentota Thiele, 1925
Turricula hottentota Thiele, 1925, Wiss. Erg. Deut. Tief. Exp. "Valdivia" 17: 186, pl. 32, fig.24. Agulhas Bank, Sth. Africa, 155 metres. 7.5 x 3.1mm.

A species of *Microvoluta* Angas, family Volutomitridae.

Mitra hualpensis Philippi, 1887
Mitra hualpensis Philippi, 1887, Tert. Quart. Verst. Chiles p. 71, pl. 8, fig. 6. Hualpen, Chile; L. Pliocene. 30.0 x 14.0mm.

The species is not a mitrid and is referable to the superfamily Buccinacea.

Mitra humboldti Lea, 1833
Mitra humboldti Lea, 1833, Contrib. Geology, p. 170, pl. 6, fig. 178. Claiborne, Alabama; Eocene.

A synonym of *Caricella bolaris* (Conrad, 1833), family Volutidae.

Mitra inaspecta Deshayes, 1865
Mitra inaspecta, Deshayes, 1865, Desc. Anim. sans vert. Bass. Paris 3: 574, pl. 103, figs. 14-16. Auvers, Paris Basin; Eocene. 8.0 x 4.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra inconspicua Hutton, 1885
Mitra inconspicua Hutton, 1885. Trans. Proc. N.Z. Inst. 17: 326. Mt. Harris and Waihao greensands, New Zealand; U. Eocene. Type CM: 17.0 x 7.5mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Mitra inornata Beyrich, 1854
Mitra inornata Beyrich, 1854, Zeit. deut. geol. Gesell. 6: 413, pl. 9, figs. 2a, b. Westeregeln, Magdeburg, Germany; L. Oligocene. 4.2 x 2.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra insignis A. Adams, 1853
Mitra insignis A. Adams, 1853, Proc. Zool. Soc. London pt. 19: 132. Rains I., Pacific. Type BMNH No. 1966465: 16.8 x 6.4 x 8.7mm.

The type is a juvenile specimen of *Pyrene ligula* (Duclos, 1835), family Columbellidae.

Strigatella isabellae Gardner, 1937
Strigatella isabellae Gardner, 1937, U.S. Geol. Surv. Prof. Pap. No. 142F: 419.

This is a new combination for *Caricella isabellae* Maury, 1910, which is a species of *Enaeta* H. & A. Adams, 1853, family Volutidae.

Mitra jervisensis Laseron, 1951
Mitra jervisensis Laseron, 1951, Rec. Aust. Mus. 22 (4): 341, fig. 4. Jervis Bay, N.S.W., Australia, 15 fathoms. Type AMS: 11.0 x 4.2 x 5.0mm.

According to Garrard (1969), the species is a synonym of *Microvoluta royana* Iredale, 1924, family Volutomitridae.

Mitra kobayashii Yokoyama, 1927
Mitra kobayashii Yokoyama, 1927, J. Fac. Sci. Imp. Univ. Tokyo 2 (4): 173, pl. 47, fig. 5. Kami-Tsuye, Kaga, Japan; Pliocene. 26.0 x 12.0mm.

According to Hatai & Nisiyama (1952), the species belongs to the family Cancellariidae.

Vexillum labechei Roualt, 1850
Vexillum labechei Roualt, 1850, Bull. Soc. geol. France 7: 734.

The species is not a mitrid.

Mitra labiata Deshayes, 1865
Mitra labiata Deshayes, 1865, Desc. Anim. sans vert. Bass. Paris 3: 571. Paris Basin; Eocene.

A synonym of *Mitreola raricosta* (Lamarck, 1803), family Volutidae.

Mitra labiata Grzybowski, 1899
Mitra labiata Grzybowski, 1899. Neu. Jahrb. Mineral. 12: 649, pl. 19, fig. 10. Payta, Talara form., N. Peru; Miocene. 15.0mm.

The species is not a mitrid and may probably belong to the Columbellidae. It is a homonym of *Mitra labiata* Deshayes, 1865.

Mitra labratula Lamarck, 1803
Mitra labratula Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 58; *Mitra labratella* Lamarck, Tabl. Encycl. Méth. p. 1, pl. 392, figs. 3a, b. Grignon, Paris Basin; Eocene. 20.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra labrosa Deshayes, 1835
Mitra labrosa Deshayes, 1835, Desc. coq. foss. env. Bass. Paris 2: 673, pl. 88, figs. 20, 21 (as *M. lebrosa* in text of 1835 and *M. labrosa* in plate expl. of 1837). Mouchy, Paris Basin; Eocene. 26.0mm.

The species is probably conspecific with *Mitreola monodonta* (Lamarck, 1803), family Volutidae.

Mitra lachryma Reeve, 1845
Mitra lachryma Reeve, 1845, Conch. Icon. pl. 32, sp. 258. Loc.: ?

A synonym of *Anarithma metula* (Hinds, 1843), family Columbellidae.

Mitra lajoyi Deshayes, 1835
Mitra lajoyi Deshayes, 1835, Desc. coq. foss. env. Bass. Paris 2: 678, pl. 89, figs. 5, 6. Assy, Valmondois, Paris Basin; Eocene. 50.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra lamberti Fleming, 1828
Mitra lamberti Fleming, 1828, Hist. Brit. Anim. p. 333 (ref. to Sowerby, 1816, Min. Conch. pl. 129). Crag Marl, England; Pliocene.

A synonym of *Voluta lamberti* J. de C. Sowerby, 1816, family Volutidae.

Turricula leda Whitfield, 1892
Turricula leda Whitfield, 1892, Mon. U.S. Geol. Surv. 18: 93, pl. 11, fig. 7. U. Cretaceous.

The species is not a mitrid and may be referable to *Exilia* Conrad, 1860 family Fasciolariidae.

Mitra lennieri Cossmann & Pissario, 1901
Mitra lennieri Cossmann & Pissarro, 1901, Bull. Soc. géol. Normandie 20: 88, pl. 10, fig. 19. Fresville, Cotentin, France; Eocene. 10.0 x 7.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra leontocroma Brusina, 1866
Mitra leontocroma Brusina, 1866, Verh. zool.-bot. Gesell. Wien Suppl. 16: 34. Dalmatia, Adriatic. 7.0 x 3.0mm.

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835), family Turridae.

Mitra (Conomitra) fusoides lepa de Gregorio, 1890
Mitra (Conomitra) fusoides lepa de Gregorio, 1890, Ann. Géol. Pal. Palermo 7: 72, pl. 5, figs. 35, 36. Gosport, Alabama; Eocene.

A synonym of *Conomitra fusoides* (Lea, 1833), family Volutomitridae.

Mitra ligata Tate, 1889
Mitra ligata Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 139, pl. 5, fig. 4. Lower beds at Muddy Creek, Victoria, Australia; M. Miocene. 7.0 x 3.0 x 4.0mm.

A synonym of *Microvoluta pentaploca* Finlay, 1927, family Volutomitridae, and a homonym of *Mitra ligata* A. Adams, 1853.

Vexillum ligatum Suter, 1917
Vexillum ligatum Suter, 1917, NZ. Geol. Surv. Pal. Bull. No. 5: 28, pl. 4, fig. 9. Waitaki River, Wharekuri, Waitaki Valley, New Zealand; U. Oligocene. Type OUM 9.0 x 4.0mm.

A synonym of *Waimatea enysi* (Hutton, 1873), family Volutomitridae.

Imbricaria limburgensis Binkhorst, 1861
Imbricaria limburgensis Binkhorst, 1861, Mon. Gast. Craig Limbourg, p. 16, pl. 2, figs. 8a, b (fig. c is a different species). Limbourg; U. Cretaceous. 53.0 x 22.0mm.

The species is not an *Imbricaria* nor a mitrid and probably belongs in the family Volutidae.

Turricula lincta Hutton, 1885
Turricula lincta Hutton, 1885, Trans. Proc. N.Z. Inst. 17: 326. Petane, New Zealand; L. Pleistocene; *Vexillum linctum* Suter, 1915, N.Z. Geol. Surv. Pal. Bull. No. 3: 21, pl. 8, fig. 8. Type CM: No. M-3386: 4.7 x 2.5 x 2.4mm.

The type is a juvenile specimen of *Microvoluta marginata* (Hutton, 1885), family Volutomitridae.

Mitra lineata Schumacher, 1817
Mitra lineata Schumacher, 1817, Ess. nouv. Syst. p. 239 (Ref. Chemnitz, 1780, 4: pl. 158 = error for pl. 148, figs. 1372, 1373. Loc.: ?

Schumacher's (1817) *Mitra lineata* is a composite species: the cited figure 1372 (and 1371) represents the terrestrial Jamaican snail *Achatina albolineata* Lamarck, 1822, which is probably synonymous with *Varicella leucozonias* (Gmelin, 1791), family Oleacinidae. The second cited figure 1373 is the mitrid species *Vexillum (Costellaria) sanguisugum* (Linnaeus, 1758). *Tiara lineata* Broderip, 1836, is not a secondary homonym of *Mitra lineata* Schumacher, and the currently used *Mitra erythrogramma* Tomlin, 1931, for a West American *Subcancilla* species, will become a synonym of *Subcancilla lineata* (Broderip, 1836).

Mitra lineolata Heilprin, 1887
Mitra lineolata Heilprin, 1887, Trans. Wag. Free Inst. Sci. Philad. 1: 79, 133, pl. 2, figs. 9, 9a and pl. 16a, fig. 74. Caloosahatchie, Florida; Pliocene. Type USNM.

A synonym of *Pleioptygma heilprini* Cossmann, 1899, family Volutidae, and a homonym of *Mitra lineolata* Bellardi, 1887.

Mitra longissima Giebel, 1864
Mitra longissima Giebel, 1864, Abh. Nat. Gesell. Halle 8: 16, pl. 1, fig. 12. Lattorf, Germany; L. Oligocene.

A species of the genus *Scaphella* Swainson, 1832, subgenus *Aurinia* H. & A. Adams, 1853, family Volutidae.

Vexillum lornense Marwick, 1926
Vexillum lornense Marwick, 1926, Trans. Proc. N.Z. Inst. 56: 314, pl. 72, fig. 13. Waiarekan Tuffs, Lorne, N. Otago, New Zealand; U. Eocene. Type NZGS: 6.5 x 3.0mm.

A species of *Waimatea* Finlay Volutomitridae.

Mitra lyraeformis Swainson, 1821
Mitra lyraeformis Swainson, 1821, Zool. Illust., ser.1, 1: pl. 54, 2 figs. Loc.: ?

A species of the genus *Lyria* Gray, 1847, family Volutidae.

Mitra lyrata Sasso, 1827
Mitra lyrata Sasso, 1827, Giorn. Lig. Sci. Genova 1: 481 (ref. to Brocchi, 1814, pl. 3, fig. 8). Basin of Albenga, Italy; Pliocene.

A synonym of *Cancellaria varicosa* (Brocchi, 1814) and a homonym of *Mitra lyrata* Lamarck, 1822.

Pterygia magellanica Röding, 1798
Pterygia magellanica Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Adelomelon ancilla* (Lightfoot, 1786), family Volutidae.

Mitra marginata Lamarck, 1803
Mitra marginata Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 58. Grignon, Paris Basin; Eocene. 12.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Thala marginata Tenison-Woods, 1877
Thala marginata Tenison-Woods, 1877, Proc. R. Soc. Tasmania p. 108. Table Cape, Tasmania; Miocene.

A synonym of *Rugobela columbelloides* (Tenison-Woods, 1877), family Turridae.

Turricula marginata Hutton, 1885
Turricula marginata Hutton, 1885, Trans. Proc. N.Z. Inst. 17: 315, pl. 18, fig. 4. Wanganui, New Zealand; U. Pleistocene. Type CM No. M-3149: 6.1 x 2.8 x 3.5mm.

A species of *Microvoluta* Angas, family Volutomitridae.

Mesorhytis meekiana Dall, 1889
Mesorhytis meekiana Dall. 1889, Bull. Mus. Comp. Zool. Harvard 18: 172, pl. 36, fig. 7. Cuba, 250-400 fathoms. Type USNM: 15.5 x 5.0 x 9.0mm.

A juvenile specimen of Fasciolariidae.

Mitra michaudi Michelotti, 1847
Mitra michaudi Michelotti, 1847, Nat. Verh. Holl. Maat. Haarlem 3: 313, pl. 13, figs. 5, 5^1, 5^2. Turin, Italy; Miocene. 12.0mm.

A species of *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, family Turridae.

Mitra minima Seguenza, 1880
Mitra minima Seguenza, 1880, Atti R. Acc. Linc. Roma ser. 3, 6: 101, pl. 11, fig. 4. Benestare, Calabria, Italy; Miocene. 5.5 x 2.6mm.

A synonym of *Microvoluta cognatella* (Toldo, 1889), family Volutomitridae, and a homonym of *Mitra minima* Lea, 1833.

Turricula minima Vredenburg, 1823
Turricula minima Vredenburg, 1923, Rec. Geol. Surv. India 54 (3): 275, pl. 16, figs. 7a, b. Thanga, Burma; Miocene. *C.* 7.3mm.

The species is referable to the subfamily Mangeliinae, family Turridae.

Mitra miranda E. A. Smith, 1891
Mitra miranda E. A. Smith, 1891, Proc. Zool. Soc. London p. 440, pl. 34, fig. 12. Challenger St. 164B, "off Sydney, Australia, 410 fathoms" = error; probably Atlantic. Types in BMNH No. 1889. 10.12.17-24.

A synonym of *Microvoluta intermedia* (Dall, 1890), family Volutomitridae, from the West Indies.

Mitra mitraeformis Sasso, 1827
Mitra mitraeformis Sasso, 1827, Giorn. Lig. Sci. Genova 1: 481 (Ref. Brocchi, 1814, pl. 15, fig. 13). Basin of Albenga, Italy; Pliocene.

The species is not a mitrid.

Mitra mixta Lamarck, 1803
Mitra mixta Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 59. Grignon, Paris Basin; Eocene. 20.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra mokattamensis Oppenheim, 1906
Mitra mokattamensis Oppenheim, 1906, Palaeontographica 30: 325, pl. 26, figs. 6a, b. U. Mokattam beds, Egypt; Eocene. 44.0 x 13.0mm.

The species has a resemblance to *Pleioptygma* Conrad and *Aurinia* H. & A. Adams, family Volutidae.

Turricula (Mesorhytis) monilifera Pethö, 1906
Turricula (Mesorhytis) monilifera Pethö, Palaeontographica 52: 179, pl. 11, fig. 22 (= ? *Turricula monilifera* Pethö, 1896, M. kir. Foldt. Int. targ. p. 32). Peterwardein, Hungary; U. Cretaceous.

The species may be referable to *Paleopsephaea* Wade, 1926, family Fasciolariidae.

Mitra monodi Knudsen, 1956
Mitra monodi Knudsen, 1956, Bull. Inst. Franc. Afric. Noire 18A: 519, pl. 1, fig. 1. Gorée Bay, Senegal, West Africa, 15 metres. 5.9 x 2.8 x 2.7mm.

The species belongs to *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, family Turridae.

Mitra monodonta Lamarck, 1803
Mitra monodonta Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 58. Grignon, Paris Basin; Eocene. 16.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra mooreana Gabb, 1860
Mitra mooreana Gabb, 1860, J. Acad. Nat. Sci. Philad. ser. 2, 4: 383, pl. 67, fig. 24. Wheelock and Caldwell Counties, Texas; Eocene. Type ANSP No. 13273: 27.0mm.

A species of *Lapparia* Conrad, family Volutidae.

Mitra mortenseni Odhner, 1924
Mitra mortenseni Odhner, 1924, Vid. Med. Dansk. nat. For. 77: 34, pl. 1, fig. 24. Nth. Cape, N. Island, New Zealand. Type ZMUC: 14.4 x 7.3mm.

A synonym of *Waimatea obscura* (Hutton, 1873), family Volutomitridae.

Mitra (Terebrifusus) multiplicata de Gregorio, 1890
Mitra (Terebrifusus) multiplicata de Gregorio, 1890, Ann. Geol. Pal. Palermo 7: 77, pl. 5, fig. 65. Claiborne, Alabama; Eocene.

A new combination for *Terebrifusus multiplicatus* (Lea, 1841), family Buccinidae.

Mitra murchisoni Müller, 1851
Mitra murchisoni Müller, 1851, Mon. Petref. Aachner Kreidef. 2: 23, pl. 3, figs. 23a, b. Aachen, Germany; U. Cretaceous.

The species is not a mitrid and a more appropriate placement is in the genus *Longoconcha* Stephenson, 1941, family Volutidae.

Mitra mutica Lamarck, 1803
Mitra mutica Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 60. Grignon, Paris Basin; Eocene. 25.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra namnetica Cossmann, 1897
Mitra namnetica Cossmann, 1897, Bull. Soc. Sci. nat. L'Ouest 6: 242, pl. 8, figs. 30, 31. Bois-Gouet, Loire Inferieure, France; Eocene. 5.25 x 2.5 x 3.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra nana Müller, 1851
Mitra nana Müller, 1851, Mon. Petref. Aachner Kreidef. 2: 23, pl. 3, figs. 24a, b. Greensand of Vaels, Aachen, Germany; U. Cretaceous.

The proper placement of this species appears to be in the genus *Paleopsephaea* Wade, 1926, family Fasciolariidae. The specific name is a homonym of *Mitra nanus* Reeve, 1844.

Pterygia nebulosa Röding, 1798
Pterygia nebulosa Röding, 1798, Mus. Bolten, p. 51. Loc.: ?

This is an earlier name for *Voluta picta* Dillwyn, 1817, and *Marginella nubeculata* Lamarck, 1822, family Marginellidae.

Mitra nice Nardo, 1847
Mitra nice Nardo, 1847, Sin. mod. spec. Lago Veneto p. 47. Lago Veneto, Italy.

The species is not a mitrid.

Mitra nitida Pictet & Campiche, 1864
Mitra nitida Pictet & Campiche, 1864, Mater. Paleont. Suisse 3: 684. Gosau, Austria; U. Cretaceous.

This is a new combination for *Fasciolaria nitida* Zekeli, 1852, and a homonym of *Mitra nitida* A. Adams, 1853.

Mitra nodosa Borson, 1820
Mitra nodosa Borson, 1820, Mem. R. Acc. Sci. Torino 25: 208, pl. 1, fig. 9. Loc.: ?

A juvenile specimen of *Strombus bonellii* Brongniart, 1823, family Strombidae.

Strigatella (Mitreola) nodulosa Doncieux, 1908
Strigatella (Mitreola) nodulosa Doncieux, 1908, Ann. Univ. Lyon 22: 60, pl. 3, figs. 7a, b. Fabrezan, France; U. Paleocene. 9.5 x 4.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra obliquata Deshayes, 1835
Mitra obliquata Deshayes, 1835, Desc. coq. foss. env. Bass. Paris 2: 677, pl. 89, fig. 3, & pl. 90, figs. 5, 6. Parnes, Mouchy, Paris Basin; Eocene.

A species of *Mitreola* Swainson, family Volutidae, and a homonym of *Mitra obliquata* Lamarck, 1811.

Mitra obscura Hutton, 1873
Mitra obscura Hutton, 1873, Cat. Mar. Moll. Ech. N.Z. p. 19. Bay of Islands, New Zealand. Type DM: 16.0 x 8.0 x 9.0mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Mesorhytis obscura Wade, 1926
Mesorhytis obscura Wade, 1926, U.S. Geol. Surv. Prof. Pap. 137: 132, pl. 46, figs. 2, 6. Ripley form., Tennessee; U. Cretaceous.

A species of *Graphidula* Stephenson, 1941, family Fasciolariidae.

Mitra obsoleta Philippi, 1836
Mitra obsoleta Philippi, 1836, Enum. Moll. Siciliae 1: 230. Catania, Sicily, Italy.

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835) and a synonym of *Mitra obsoleta* Grateloup, 1834.

Mitra olivoidea Cantraine, 1835
Mitra olivoidea Cantraine, 1835, Bull. Acad. R. Sci. nat. Bruxelles 2: 391. Mediterranean. Type IRSN: 5.4 x 2.7mm.

This is the type species of *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, 1883, family Turridae.

Mitra olivula Baudon, 1853
Mitra olivula Baudon, 1853, J. Conchyl. 3: 331, pl. 9, fig. 13. Sant Félix, Oise, France; Eocene. 18.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra orcutti Dall, 1920
Mitra orcutti Dall, 1920, Nautilus 33: 103. La Jolla, near San Diego, California. Type USNM No. 334567: 6.0 x 2.5 x 3.2mm.

A synonym of *Mitromorpha gracilior* (Tryon, 1884), family Turridae.

Mitra othone Tenison-Woods, 1880
Mitra othone Tenison-Woods, 1880, Proc. Linn. Soc. N.S.W. 4: 8, pl. 2, fig. 4. Muddy Creek, Victoria, Australia; Miocene. 10.0 x 4.5mm.

A species of *Waimatea* Finlay, family Volutomitridae.

Mitra pactilis Conrad, 1833
Mitra pactilis Conrad, 1833, Foss. shells Tert. form. N. America 1: 46; 1835, pl. 16, fig. 21. Claiborne Bluff, left bank of Alabama River, Alabama; Eocene. Type ANSP No. 13576.

A species of *Lapparia* Conrad, family Volutidae.

Mitra paeteli Dohrn, 1860
Mitra paeteli Dohrn, 1860, Malakozool. Blätter 7: 125. Africa meridionalis ? 18.0 x 10.0 x 12.0mm. Type lost.

According to the description, the species has an inflected labial lip with 9 denticles and a calloused columella with 4 folds. The species appears to be a *Mitrella* Risso, 1826, family Columbellidae.

Vexillum pailoloanum J. Cate, 1963
Vexillum pailoloanum J. Cate, 1963, Veliger 6 (1): 29, pl. 6, figs. 11-13. Pailolo Channel between Maui and Malokai, Hawaiian Islands, 256-283 fathoms. Type USNM No. 173008: 18.0 x 7.0 x 10.0mm.

A species of *Volutomitra* H. & A. Adams, 1853, family Volutomitridae.

Mitra panaulax Cossmann 1901
Mitra panaulax Cossmann, 1901, Ess. paléoc. comp. 4: 25, pl. 10, figs. 16, 17. Loire-Inferieure: Miocene.

The species was first described on p. 25 as a *Mitra* with a reference to figures. On page 255 the species was diagnosed as *Mitromorpha panaulax*. The taxon is a *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, family Turridae.

Mitra (Mitromorpha) paraptycha Böttger, 1906
Mitra (Mitromorpha) paraptycha Bottger, 1906, Verh. Mitt. Ver. Nat. Hermannstadt 54: 13. Kostej, Banat, Transsylvania; Miocene. Type SMF: 10.5 x 4.0 x 6.0mm.

A species of *Mitromorpha* Carpenter, family Turridae.

Mitra parisiensis Deshayes, 1832
Mitra parisiensis Deshayes, 1832, Encycl. Méth. Hist. Nat. ed. 2, 2: 470. Parnes, Paris Basin; Eocene. 47.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Vexillum parki Allan, 1926
Vexillum parki Allan, 1926, Trans. Proc. N.Z. Inst. 56: 341, pl. 77, fig. 2. McCullough's Bridge, Waihao, New Zealand; U. Eocene. 15.0 x 6.0mm. Holotype lost, syntypes in AIM.

A species of *Waimatea* Finlay, family Volutomitridae.

Mitra parkinsoni Lea, 1833
Mitra parkinsoni Lea, 1833, Contrib. Geology p. 175, pl. 6, fig. 184. Claiborne, Alabama: Eocene.

A synonym of *Turbinella pyruloides* Conrad, 1832, family Volutidae.

Mitra parva J. de C. Sowerby, 1823
Mitra parva J. de C. Sowerby, 1823, Min. Conch. 5: 37, pl. 430, fig. 1. Barton Cliffs, England; Eocene.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra pauciplicata Yokoyama, 1928
Mitra pauciplicata Yokoyama, 1928, J. Fac. Sci. Imp. Univ. Tokyo ser. 2, 2: 334, pl. 67, fig. 2. Kounji, Japan; Pliocene.

According to Hatai & Nisiyama (1952), the species belongs to the genus *Phenacoptygma* Dall, family Volutidae.

Pterygia peregrina Röding, 1798
Pterygia peregrina Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Adelomelon ancilla* (Lightfoot, 1786), family Volutidae.

Mitra pergracilis Harris, 1899
Mitra pergracilis Harris, 1899, Bull. Americ. Paleont. 3 (11): 39, pl. 4, fig. 10 (in error *M. perexilis* on plate expl.). Gregg's Landing, Alabama; L. Eocene.

This is a new combination for *Fasciolaria pergracilis* Aldrich, 1886.

Mitra perlonga Martin, 1884
Mitra perlonga Martin, 1884, Samml. geol. Reichs-Mus. Leiden 3: 93, pl. 5, fig. 93. Ngembak, Java, Indonesia; Pliocene.

The species should be referred to the subfamily Mitromorphinae, family Turridae.

Mitra perminuta Sandberger, 1863
Mitra perminuta Sandberger, 1863, Conchyl. Mainz. Tert. p. 252, pl. 19, fig. 4. Weinheim, Waldböckelheim, Germany; M. Oligocene.

A species of *Conomitra* Conrad, family Volutomitridae.

Pterygia persicula Röding, 1798
Pterygia persicula Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

This is the same species as *Marginella persicula* (Linnaeus, 1758), family Marginellidae.

Mitra (Strigatella) perturbatrix Maury, 1917
Mitra (Strigatella) perturbatrix Maury, 1917. Bull. Americ. Paleont. 5: 76, pl. 14, figs. 1, 2. Rio Gurabo, Santo Domingo, Dominica: Miocene. 20.0 x 8.5mm.

A species of *Enaeta* H. & A. Adams, 1853, family Volutidae.

Strigatella peruviana Olsson, 1931
Strigatella peruviana Olsson, 1931, Bull. Americ. Paleont. 17: 209, pl. 20, figs. 4, 6. Near Puercotilla, Chira form., N. Peru; L. Oligocene. 21.0 x 12.0 x 15.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra (Mitreola) pezanti Cossmann, 1906
Mitra (Mitreola) pezanti Cossmann, 1906, Ann. Soc. R. Malac. Belg. 41: 267, pl. 5, fig. 202-22. Boury, Paris Basin; Eocene. 30.0 x 12.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra pica Reeve, 1845
Mitra pica Reeve, 1845, Conch. Icon. pl. 31, sp. 247. Loc.: ? Types in BMNH No. 1967838.

A synonym of *Waimatea obscura* (Hutton, 1873), family Volutomitridae, and a homonym of *Mitra pica* Deshayes in Deshayes & Edwards, 1844.

Mitra pirula Yokoyama, 1922
Mitra pirula Yokoyama, 1922, J. Coll. Sci. Imp. Univ. Tokyo 44 (1): 51, pl. 2, fig. 9. Shito, U. Musashino form., Japan; Pleistocene.

A juvenile specimen of *Microvoluta hondana* (Yokoyama, 1922), family Volutomitridae.

Mitra piruliformis Müller, 1851
Mitra piruliformis Muller, 1851, Mon. Petref. Aachner Kreidef. 2: 23, pl. 3, figs. 25a, b. Lusberg and Vaels, Aachen, Germany; U. Cretaceous.

This is the type species of *Ficulomorpha* Holzapfel, 1888, family Volutidae.

Mitra (Thala) pleurotomoides E. A. Smith, 1890
Mitra (Thala) pleurotomoides E. A. Smith, 1890, Proc. Zool. Soc. London p. 266, pl. 23, fig. 10. St. Helena, Atlantic. 5.0 x 2.0mm.

The species belongs in the subfamily Mitromorphinae, family Turridae.

Vexillum plicatellum Marshall & Murdoch, 1923
Vexillum plicatellum Marshall & Murdoch, 1923, Trans. Proc. N.Z. Inst. 54: 123, pl. 12, fig. 3. McCullough's Bridge, Waihao River, New Zealand; U. Eocene. 7.5 x 4.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra plicifera Yokoyama, 1920
Mitra plicifera Yokoyama, 1920, J. Coll. Sci. Imp. Univ. Tokyo 39: 48, pl. 2, figs. 16a, b. Koshiba, L. Musashino, Miura Peninsula, Japan; L. Pliocene.

According to Kuroda & Habe (1950), the species is a synonym of *Benthovoluta hilgendorfi* (von Martens, 1897), family Volutidae. It is also a homonym of *Mitra plicifera* S. V. Wood, 1848.

Austromitra plicifera Marwick, 1928
Austromitra plicifera Marwick, 1928, Trans. Proc. N.Z. Inst. 58: 485, fig. 129. Whenuataru Peninsula, Pitt I., Chatham I., New Zealand; L. Pliocene. Type NZGS: 10.0 x 5.5mm.

A species of *Parvimitra* Finlay, 1930, family Volutomitridae.

Mitra (Volutomitra) porcellana Melvill & Standen, 1912
Mitra (Volutomitra) porcellana Melvill & Standen, 1912, Trans. R. Soc. Edinburgh 48: 355, fig. 21. Scotia Bay, S. Orkneys, 9-10 fathoms; Burdwood Bank, 56 fathoms. Type *c.* 14.0mm.

The species has features of *Paradmete* Strebel, 1908, family Volutomitridae, and of Subantarctic Marginellidae.

Imbricaria porphyria Verco, 1896
Imbricaria porphyria Verco, 1896, Trans. R. Soc. Sth. Aust. 20: 227, pl. 8, figs. 5, 5a. Backstairs Passage, Investigator Str., Sth. Australia, 15-20 fathoms.

A species of *Peculator* Iredale, 1924, family Volutomitridae.

Mitra porrecta F. E. Edwards, 1856
Mitra porrecta F. E. Edwards, 1856, Mon. Palaeont. Soc. England 3 (2): 185, pl. 24, figs. 7a, b, c. Barton, Bracklesham Bay, England; Eocene. Type BMNH Dept. Geol. No. 71190: 7.7mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra potomacensis Clark & Martin, 1901
Mitra potomacensis Clark & Martin, 1901, Maryland Geol. Surv. p. 133, pl. 21, fig. 11. Popes Creek, Aquian and Nanjemoy form., Maryland; Paleocene. 12.0 x 3.5mm.

The species appears to be a small *Paleopsephaea* Wade, 1926, family Fasciolariidae.

Mitra prevosti Roualt, 1848
Mitra prevosti Roualt, 1848, Bull. Soc. géol. France 5: 204; *Voluta prevosti* Roualt, 1850, Mém. Soc. géol. France 3 (5): 499, pl. 18, fig. 14. France; Eocene.

The species should be assigned to the family Volutidae.

Mitra prisca Deshayes, 1865
Mitra prisca Deshayes, 1865, Desc. Anim. sans vert. Bass. Paris 3: 577, pl. 103, figs. 8-10. Brimont, Châlons-sur-Vesle, Paris Basin; Paleocene. 15.0 x 6.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra pristina Yokoyama, 1923
Mitra pristina Yokoyama, 1923, J. Coll. Sci. Imp. Univ. Tokyo 45: 8, pl. 1, figs. 8-12. Dainichi, Totomi, Japan; Pliocene.

According to Hatai & Nisiyama (1952) the species belongs in the family Cancellariidae. *Mitra pristina* Yokoyama, 1926, however, is the species *Nassarius (Coreophos) nakamurai* Kuroda, family Nassariidae.

Vexillum (Latiromitra) problematicum Ponder, 1968
Vexillum (Latiromitra) problematicum Ponder, 1968, Rec. Dom. Mus. 6 (4): 45, pl. 4, figs. 55, 56. Portobello Marine Biol. Station, E. of Taiaroa Heads, New Zealand, 65 fathoms. Type DM No. M-21553: 33.1 x 12.9 x 18.2mm.

A species of *Volutomitra* H. & A. Adams, 1853, subgenus *Latiromitra* Locard, 1897, family Volutomitridae.

Mitra (Pleioptygma) prodroma Gardner, 1937
Mitra (Pleioptygma) prodroma Gardner, 1937, U.S. Geol. Surv. Prof. Pap. No. 142F: 407, pl. 48, figs. 6, 7. 1 mile below Baileys Ferry, Chipola River, Florida; L. Miocene. Type USNM No. 114326: 68.0 x 22.5 x 39.0mm.

A species of *Pleioptygma* Conrad, family Volutidae.

Pterygia pruna Röding, 1798
Pterygia pruna Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Marginella prunum* (Gmelin, 1791), family Marginellidae.

Mitra pumila J. de C. Sowerby, 1823
Mitra pumila J. de C. Sowerby, 1823, Min. Conch. 5: 37, pl. 430, fig. 2. Barton Cliff, England; Eocene.

A synonym of *Conomitra parva* (J. de C. Sowerby, 1823), family Volutomitridae.

Mitra cancellina var. **quadriplicata** Nyst in Dewalque, 1868
Mitra cancellina var. *quadriplicata* Nyst in Dewalque, 1868, Prodr. géol. Belg., p. 402. Belgium; Tertiary.

The species is a probable synonym of *Mitreola labratula* (Lamarck, 1803), family Volutidae.

Mitra rangii Lesson, 1837
Mitra rangii Lesson, 1837, Prodr. Méduses p. 10; Roret's Suite Buffon, Acaléphes, p. 280.

The species is not a mollusc.

Mitra raricosta Lamarck, 1803
Mitra raricosta Lamarck, 1803, Ann. Mus. d'Hist. Nat. Paris 2: 59. Grignon, Paris Basin; Eocene. 9 lignes (= 20.3mm).

A species of *Mitreola* Swainson, family Volutidae.

Mitra ravni Harder, 1913
Mitra ravni Harder, 1913, Danm. Geol. Unders. ser. 2, 22: 84, 129, pl. 7, figs. 2a, b, c, 3. Aarhus, Denmark; Oligocene.

The species probably belongs to the family Volutomitridae.

Turricula reileyi Whitfield, 1892
Turricula reileyi Whitfield, 1892, U.S. Geol. Surv. Mon. 18: 92, pl. 11, fig. 8. Freehold, Monmouth form., New Jersey; U. Cretaceous.

The species is not a mitrid and is probably an *Exilia* Conrad, family Fasciolariidae.

Mitra roborea Reeve, 1845
Mitra roborea Reeve, 1845, Conch. Icon. pl. 37, sp. 306. Loc.: ?.

The figured specimen appears to be a *Latirus* Montfort, family Fasciolariidae.

Turricula (Costellaria) ruellensis Gougerot, 1968
Turricula (Costellaria) ruellensis Gougerot, 1968, Mem. Bur. Rech. Geol. & Min. France No. 58: 234, pl. 2, fig. 5. Le Ruel, Val d'Oise, Paris Basin; U. Eocene. Type Geol. Lab. Faculty of Sci. Paris; 3.1 x 1.5mm.

A juvenile specimen of *Conomitra* Conrad, family Volutomitridae.

Mitra rugosa Philippi, 1847
Mitra rugosa Philippi, 1847, Palaeontographica 1: 78, pl. 10a, fig. 7. Germany; Tertiary.

A synonym of *Voluta semigranosa* Nyst, 1845, family Volutidae, and a homonym of *Mitra rugosa* Swainson in Sowerby, 1825.

Vexillum (Costellaria) rutidolomum Suter, 1917
Vexillum (Costellaria) rutidolomum Suter, 1917, N.Z. Geol. Surv. Pal. Bull. No. 5: 29, pl. 4, fig. 10. Foot of Mt. Horrible, New Zealand; L. Miocene. Type CM No. M-3140; 29.7 x 12.8 x 18.9mm.

A species of *Proximitra* Finlay, 1927, family Volutomitridae.

Mitra lineolata saginata Tucker & Wilson, 1933
Mitra lineolata saginata Tucker & Wilson, 1933, Bull. Americ. Paleont. 18 (66)): 74, pl. 1, figs. 8, 9. Acline, Florida; Miocene. Type USNM: 11.0 x 39.0mm.

A variant of *Pleioptygma heilprini* (Cossmann, 1899), family Volutidae.

Mitra scabra J. de C. Sowerby, 1823
Mitra scabra J. de C. Sowerby, 1823, Min. Conch. 4: 142, pl. 401, 4 figs. Barton beds, England; Eocene. Type BMNH Dept. Geol.

A species of *Mitreola* Swainson, family Volutidae.

Mitra scalariformis Borson, 1820
Mitra scalariformis Borson, 1820, Mem. R. Acc. Sci. Torino 25: 306, pl. 1, fig. 27. Italy; Tertiary.

The species belongs in the family Cancellariidae.

Mitra secalina Koenen, 1890
Mitra secalina Koenen, 1890, Abh. k. Preuss. geol. Reichs. 10 (2): 539, pl. 38, figs. 6a, b, c. Lattorf, Germany; L. Oligocene. 5.6 x 2.2mm.

A species of *Conomitra* Conrad, family Volutomitridae, and a homonym of *Mitra secalina* Gould, 1860.

Mitra sellei de Raincourt, 1885
Mitra sellei de Raincourt, 1885, Bull. Soc. géol. France 13: 472, pl. 15, fig. 8. France; Eocene.

A synonym of *Mitreola raricosta* (Lamarck, 1803), family Volutidae.

Mitra parva var. **semilaevis** F. E. Edwards, 1856
Mitra parva var. *semilaevis* F. E. Edwards, 1856, Mon. Paleont. Soc. England 3 (2): 183. Barton, Alum Bay, England; Eocene.

A synonym of *Conomitra parva* (J. de C. Sowerby, 1823), family Volutomitridae.

Mitra semilaevis Koenen, 1885
Mitra semilaevis Koenen, 1885, Abh. k. Gesell. Wiss. Göttingen 32: 45, pl. 2, figs. 15a, b, c. Copenhagen, Denmark; Paleocene. 6.5 a 3.6 a 3.7mm.

A synonym of *Conomitra danensis* (Cossmann, 1899), family Volutomitridae, and a homonym of *Mitra semilaevis* F. E. Edwards, 1856.

Mitra semimarginata Beyrich, 1854
Mitra semimarginata Beyrich, 1854, Zeit. deut. geol. Gesell. 6: 96, pl. 8, figs. 7a, b. Mecklenburg, Sternberg form., Germany; Oligocene. 7.6 x 3.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra semisculpta Beyrich, 1854
Mitra semisculpta Beyrich, 1854, Zeit. deut. geol. Gesell. 6: 419, pl. 8, figs. 8a, b. Mecklenburg, Sternberg form., Germany; Oligocene. 8.5 a 3.3mm.

A species of *Conomitra* Conrad, family Volutomitridae, and a homonym of *Mitra semisculpta* Adams & Reeve, 1850.

Mitra (Volutomitra) separanda von Maltzan, 1884
Mitra (Volutomitra) separanda von Maltzan, 1884, Nachr. deut. Malak Gesell. 16: 72. Gorée, Senegambia, West Africa.

A species of *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, family Turridae.

Mitra soellingensis Speyer, 1864
Mitra soellingensis Speyer, 1864, Palaeontographica 9: 257, pl. 1, figs. 1a, b. Söllingen, Germany; Oligocene. 7.0 x 3.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra spinosa Pictet & Campiche, 1864
Mitra spinosa Pictet & Campiche, 1864, Mater. Paleont. Suisse 3: 684 (Ref. to Zekeli, 1852, p. 63, pl. 16, fig. 12), Gosau, Austria; U. Cretaceous.

A new combination for *Fasciolaria spinosa* Zekeli, 1852, which appears to belong to the Turridae.

Callithea spreta A. Adams, 1864
Callithea spreta A. Adams, 1864, J. Linn. Soc. London 7: 201. Mino-Sima, Japan, 63 fathoms. Types BMNH No. 1967887: 8.2mm; 7.8mm; 7.7mm.

The species belongs to the subfamily Mitromorphinae, family Turridae.

Mitra staminea Conrad, 1848
Mitra staminea Conrad, 1848, Proc. Acad. Nat. Sci. Philad. 3: 289; 1848, J. Acad. Nat. Sci. Philad. 1 (2): 120, pl. 12, fig. 4. Vicksburg, Mississippi; Oligocene. 0.4 inch.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra striarella Calcara, 1841
Mitra striarella Calcara, 1841, Mem. Conch. Foss. Altavilla p. 66, pl. 2, fig. 9. Altavilla, Italy; Pliocene.

A synonym of *Mitrolumna olivoidea* (Cantraine, 1835), family Turridae.

Mitra striata Lea, 1833
Mitra striata Lea, 1833, Contrib. Geology p. 174, pl. 6, fig. 184. Claiborne, Alabama; Eocene.

A synonym of *Turbinella pyruloides* Conrad, 1832, family Volutidae, and a homonym of *Mitra striata* Eichwald, 1830.

Mitra striata Brusina, 1865
Mitra striata Brusina, 1865, Vehr. zool.-bot. Gesell. Wien 15: 14. Zara, Dalmatia, Yugoslavia.

A synonym of *Columbella typostigma* (Brusina, 1866) and a homonym of *Mitra striata* Eichwald, 1830.

Mitra subcostulata d'Orbigny, 1852
Mitra subcostulata d'Orbigny, 1852, Prodr. Paleont. Strat. Univ. 3 :53. Mouchy, Paris Basin; Eocene.

Proposed as a substitute name for *Mitra costulata* Deshayes, 1835 (non Risso, 1826), the species is a *Mitreola* Swainson, family Volutidae.

Mitra subcrenularis Tate, 1889
Mitra subcrenularis Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 142, pl. 5, fig. 6. Adelaide Bore, Sth. Australia; Pliocene. 11.0 x 4.5 x 6.5mm.

A species of *Microvoluta* Angas, family Volutomitridae.

Mitra subdecussata d'Orbigny, 1852
Mitra subdecussata d'Orbigny, 1852, Prodr. Paleont. Strat. Univ. 3: 53. Tour, France; Miocene.

The species is a synonym of *Mitrolumna decussata* (Dujardin, 1837), family Turridae. The substitute name proposed by d'Orbigny is superfluous since *Mitra decussata* Dujardin is not a secondary homonym of *Voluta decussata* Gmelin, 1791.

Mitra subplicata Deshayes, 1835
Mitra subplicata Deshayes, 1835, Desc. coq. foss. env. Bass. Paris 2: 675, pl. 89, figs. 1, 2. Grignon, Parnes, Valmondois, Paris Basin; Eocene. 33.0mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra subpontis Harris, 1896
Mitra subpontis Harris, 1896, Bull. Americ. Paleont. 1 (4): 86, pl. 8, figs. 7, 7a. Ft. Gaines, U. beds of Midway horizon, Georgia; Paleocene. 28.0mm.

The species has a prominent varix on the body whorl, 4 strong and subequal folds anteriorly and 2 to 3 smaller folds posteriorly. It is not a mitrid and may possibly belong to the family Fasciolariidae.

Pterygia subterranea Röding 1798
Pterygia subterranea Röding, 1798, Mus. Bolten. p. 51. Loc.: ?

This is the same as *Pterygia effossa* Röding, 1798, and is a prior name for *Eucithara citharella* (Lamarck, 1822), family Turridae.

Mitra subulata Grateloup, 1847
Mitra subulata Grateloup, 1847, Conch. foss. terr. Tert. Adaour, Atlas pl. 1, fig. 18. Dax, France; L. Miocene.

A synonym of *Columbella subulata* Brocchi, 1814, family Columbellidae, and a homonym of *Mitra subulata* Lamarck, 1811.

Mitra sulcifera Koenen, 1890
Mitra sulcifera Koenen, 1890, Abh. k. Preuss. geol. Reichs. 10 (2): 535, pl. 38, figs. 2a, b, c. Lattorf, Germany; Oligocene. 8.4 a 3.3mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Vexillum suteri Finlay, 1924
Vexillum suteri Finlay, 1924, Proc. Malac. Soc. London 16 (2): 102. Waitaki River, Wharekuri, Waitaki Valley, New Zealand; U. Oligocene.

Proposed as a substitute name for *Vexillum ligatum* Suter, 1917, the species is a synonym of *Waimatea enysi* (Hutton, 1873), family Volutomitridae.

Mitra tenuiplicata Vasseur, 1881
Mitra tenuiplicata Vasseur, 1881, Rech. geol. terr. Tert. France, Paleont. Atlas pl. 1, fig. 16. Bassin Campbon, France; Eocene.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra terebraeformis Conrad, 1848
Mitra terebraeformis Conrad, 1848, J. Acad. Nat. Sci. Philad. ser. 2, 1: 132, pl. 14, fig. 30. Gosport, Alabama; Eocene.

This is the type species of *Pyramimitra* Conrad, 1865, family Buccinidae.

Mitra teretiuscula Thiele, 1925
Mitra teretiuscula Thiele, 1925, Wiss. Erg. deut. Tief. Exp. "Valdivia" 17: 185, pl. 20, fig. 23. Agulhas Bank, Sth. Africa, 155 metres. 8.0 x 30.mm.

A species of *Microvoluta* Angas, family Volutomitridae.

Mitra teraptycta Cossmann, 1885
Mitra tetraptycta Cossmann, 1885, J. Conchyl. 33: 128, pl. 6, fig. 8. Herouval, France; Eocene. 8.0 x 4.0mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Turricula (Conomitra) texana Harris, 1895
Turricula (Conomitra) texana Harris, 1895, Proc. Acad. Nat. Sci. Philad. 47: 69, pl. 6, fig. 11. Well at College Sta., Brazos County, Claiborne, Texas; M. Eocene. 7.5 x 3.0mm. Type lost.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra (Thala?) torticula Dall, 1889
Mitra (Thala ?) torticula Dall, 1889, Bull. Mus. Comp. Zool. Harvard 18: 162, pl. 15, fig. 8. Off Morro, Havana, Cuba, 400 fathoms. Type USNM No. 508727: 12.2 x 4.0 x 5.5mm.

A species of *Mitromorpha* Carpenter, 1865, family Turridae.

Mitra tringa Lamarck, 1811
Mitra tringa Lamarck, 1811, Ann. Mus. d'Hist. Nat. Paris 17: 211. Mediterranean and coasts of Africa.

A new combination for *Voluta tringa* Linnaeus, 1758, family Columbellidae.

Mitra turgidula Borson, 1820
Mitra turgidula Borson, 1820, Mem. R. Acc. Sci. Torino 25: 207. Piedmont, Italy; Pliocene.

A new combination for *Columbella turgidula* (Brocchi, 1814), family Columbellidae.

Mitra typostigma Brusina, 1866
Mitra typostigma Brusina, 1866, Vehr. zool.-bot. Gesell. Wien Suppl. 16: 67. Zara, Dalmatia, Yugoslavia.

Proposed as a substitute name for *Mitra striata* Brusina, 1865 (non Eichwald, 1830), the species belongs in the family Columbellidae.

Mitra umbilicaris Sasso, 1827
Mitra umbilicaris Sasso, 1827, Giorn. Lig. Sci. Genova 1: 481 (Ref. to Brocchi, 1814, pl. 3, figs. 10, 11). Albenga Basin, Italy; Miocene.

The species belongs in the family Cancellariidae.

Mitra cotteaui var. **umbilicata** Cossmann & Lambert, 1884
Mitra cotteaui var. *umbilicata* Cossmann & Lambert, 1884, Mém. Soc. géol. France 3: 180, pl. 6, figs. 13c, d. Pierrefitte, d'Etampes, France; Oligocene. 19.0 x 7.0mm.

A synonym of *Conomitra cotteaui* (Cossmann & Lambert, 1884), family Volutomitridae.

Mitra varicosa Sowerby, 1850
Mitra varicosa Sowerby, 1850, Quart. J. Geol. Soc. London 6: 46. Dominica, Caribbean; Miocene.

This is the type species of *Paraborsonia* Pilsbry, 1922, family Turridae.

Mitra varicosa Tate, 1889
Mitra varicosa Tate, 1889, Trans. R. Soc. Sth. Aust. 11: 138, pl. 5, fig. 1. Adelaide Bore, Sth. Australia; Pliocene. 24.0 x 10.0 x 13.0mm.

The figured specimen appears to be a *Latirus* Montfort, family Fasciolariidae. The specific name is a homonym of *Mitra varicosa* Sowerby, 1850.

Mitra ventricosa Hutton, 1873
Mitra ventricosa Hutton, 1873, Cat. Tert. Moll. Echin. N.Z. p. 8. Broken River, New Zealand; U. Oligocene.

The species belongs in the family Marginellidae. The specific name is a homonym of *Mitra ventricosa* Risso, 1826.

Mitra vicina Briart & Cornet, 1871
Mitra vicina Briart & Cornet, 1871, Mem. Acad. R. Sci. Lett. Art. Belg. 36: 70, pl. 5, figs. 4a, b. Mons, Belgium; Paleocene. 12.5 x 5.5mm.

The species belongs in the family Volutidae.

Mitra vicksburgensis Conrad, 1848
Mitra vicksburgensis Conrad, 1848, Proc. Acad. Nat. Sci. Philad. 3: 289. Vicksburg, Mississippi; Oligocene. Type ANSP No. 13458.

A synonym of *Conomitra staminea* (Conrad, 1848), family Volutomitridae.

Mitra (Conomitra) vincenti Cossmann, 1889
Mitra (Conomitra) vincenti Cossmann, 1889, Ann. Soc. R. Malac. Belg. 24: 187, pl. 6, figs. 5, 6. Marines, Paris Basin; Eocene. 9.0 x 5.0mm.

A synonym of *Conomitra vincentiana* (Cossmann, 1881), family Volutomitridae.

Pterygia volva Röding, 1798
Pterygia volva Röding, 1798, Mus. Bolten. p. 52. Loc.: ?

A synonym of *Amoria volva* (Gmelin, 1791), family Volutidae.

Pterygia vulgaris Röding, 1798
Pterygia vulgaris Röding, 1798, Mus. Bolten. p. 51. Loc.: ?

A synonym of *Pyrene (Columbella) mercatoria* (Linnaeus, 1758), family Columbellidae.

Vexillum waitei Suter, 1909
Vexillum waitei Suter, 1909, Rec. Canterbury Mus. 1 (2): 124, pl. 12, fig. 3. 21½ miles N.E. of Wreck Reef, Stewart I., New Zealand, 50-54 fathoms. Type CM.

This is the type species of *Egestas* Finlay, 1927, which is non mitrid and may possibly belong to the family Fasciolariidae.

Mitra washingtoniana Weaver, 1912
Mitra washingtoniana Weaver, 1912, Bull. Washington Geol. Surv. No. 15: 52, pl. 2, fig. 16. Cowlitz formation, Maryland; U. Eocene. 12.0 x 5.5mm.

A species of *Mitreola* Swainson, family Volutidae.

Mitra wateleti Briart & Cornet, 1871
Mitra wateleti Briart & Cornet, 1871, Mem. Acad. R. Sci. Lett. Art. Belg. 36: 75, pl. 5, figs. 9a, b, c. Mons, Belgium; Paleocene. 12.5 x 4.5mm.

A species of *Conomitra* Conrad, family Volutomitridae.

Mitra (Diptychomitra) werneri Böttger, 1902
Mitra (Diptychomitra) werneri Böttger, 1902, Verh. Mitt. Ver. Nat. Herrmannstadt 51: 15. Kostej, Banat, Hungary; Miocene. Type SMF.

The species belongs in the subfamily Mitromorphinae, family Turridae.

Mitra zebra Küster, 1839
Mitra zebra Küster, 1839, Syst. Conch. Cab. ed. 2, pl. 74, pl. 11, figs. 6, 7. Indian Ocean.

A synonym of *Zebramoria lineatina* Weaver & duPont, 1967, family Volutidae, and a homonym of *Mitra zebra* Lamarck, 1811.

Mitra zekelii Pictet & Campiche, 1864
Mitra zekelii Pictet & Campiche, 1864, Mater. Paleont. Suisse 3: 683. Gosau, Austria; U. Cretaceous.

Proposed as a substitute name for *Fasciolaria gracilis* Zekeli, 1852, the species belongs in the family Fasciolariidae.

Mitra zilpha Dall, 1927
Mitra zilpha Dall, 1927, Proc. U.S. Nat. Mus. 70: 49. Off Georgia and Fernandina, Florida. 6.0 x 3.0 x 3.0mm.

The species should be referred to the subfamily Mitromorphinae, family Turridae.

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TYPE SPECIMENS OF RECENT AND FOSSIL MOLLUSCA DESCRIBED BY H. J. FINLAY

PART 1. (Scissurellidae — Turbinidae)

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AUCKLAND INSTITUTE AND MUSEUM

Abstract. H. J. Finlay's type specimens of Recent and fossil mollusca deposited in the Auckland Institute and Museum are enumerated. Dimensions, illustrations, relevant synonymy and bibliography are appended.

Harold John Finlay was born in 1901 in Comilla, India, and came to New Zealand in his early childhood. Despite a severe handicap, being confined to a wheelchair practically all his life, he was an outstanding scholar who gained a MSc. in chemistry in 1921 and a DSc. degree from Otago University. He was Edmond fellow in chemistry from 1921 to 1923, National research scholar in Palaeontology from 1923 to 1926, biologist for the Fisheries Department from 1927 to 1929 and palaeontologist for Vacuum Oil Co. from 1933 to 1934. From 1937 till the time of his death in 1951, he was micropalaeontologist with the New Zealand Geological Survey. In 1939 he was elected a fellow of the Royal Society of New Zealand.

The type specimens of most species described by Finlay remained in his private collection which was acquired, through purchase, by the Auckland Institute and Museum in 1937. His collection of Recent and fossil molluscs comprised 14,000 species lots and 437 primary types. The majority of the types are either fossils, or beach-worn specimens of Recent species and generally not in the best condition. The types held by the Auckland Institute and Museum will be listed systematically, in parts, from Gastropoda to Bivalvia, and pertinent information as to registration number, number of paratypes and dimensions of holotypes will be recorded. Every attempt will be made to illustrate types not previously figured by Finlay, and unsatisfactory illustrations will be repeated, provided the types are in a reasonable condition. A complete bibliography is given in part 1, consisting of only those papers in which new species and genera of Mollusca were described by Finlay.

The date of description appearing in one of Finlay's papers (1927a) has been bracketed, pending a decision by the International Commission on Zoological Nomenclature on the acceptance of 23rd December 1926 or 10th March 1927 as the publication date.

Rec. Auckland Inst. Mus. 9: 231-247 December 15th 1972

Family **SCISSURELLIDAE**

Schismope Jeffreys, 1856

Schismope lyallensis Finlay, [1927] (Fig. 1)

1927. *Schismope lyallensis* Finlay, Trans. Proc. N.Z. Inst. 57: 340; Powell, 1937, Shellf. N.Z. p. 62; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 173: 36.

TYPE LOCALITY: Lyall Bay [Wellington].

Type material: ARM No. TM-696. Holotype: height 1.8 mm, width 2.2 mm (beach-worn). One paratype, width 1.5 mm (translucent juvenile specimen).

The only features not mentioned by Finlay are the short, spaced and minute sutural ribs which are visible under magnification on the body whorl suture.

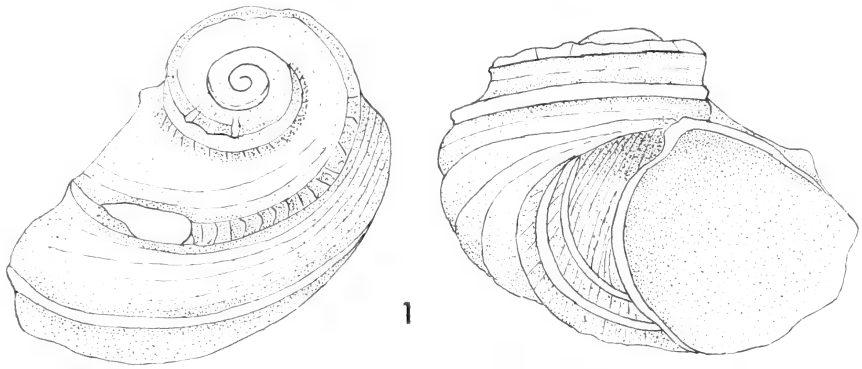


Fig. 1. *Schismope lyallensis* Finlay. Holotype TM-696: height 1.8mm.

Schismope laqueus Finlay, [1927] (Fig. 2)

1927. *Schismope laqueus* Finlay, Trans. Proc. N.Z. Inst. 57: 340, pl. 19, figs. 30, 31; Powell, 1955, Cape Exped. Ser. Bull. 15: 46.

TYPE LOCALITY: Snares Island, in 50 fathoms (91.5 m).

Type material: AIM No.TM-695. Holotype: height 0.95 mm, width 1.25 mm (beach-worn).

Between the curved axial ribs on the ventral side of the shell are diagonal striae emanating from the umbilicus.

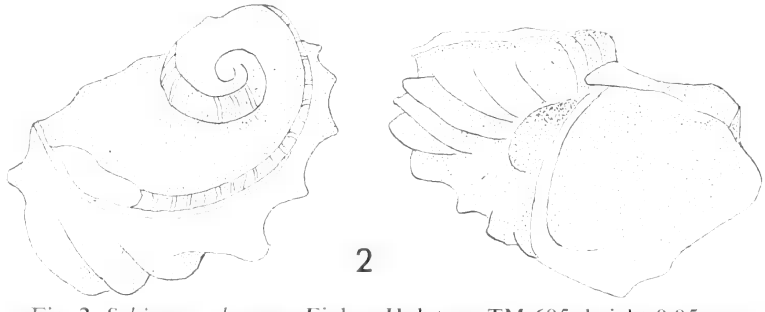


Fig. 2. *Schismope laqueus* Finlay. Holotype TM-695: height 0.95mm.

Schismope iota Finlay, [1927] (Fig. 3)

1927. *Schismope iota* Finlay, Trans. Proc. N.Z. Inst. 57: 340; Powell, 1955, Cape Exped. Ser. Bull. 15: 46.

TYPE LOCALITY: Snares Island, in 50 fathoms (91.5 m).

Type material: AIM No.TM-693. Holotype: height 0.85 mm, width 0.82 mm. Seven paratypes (all beach-worn).

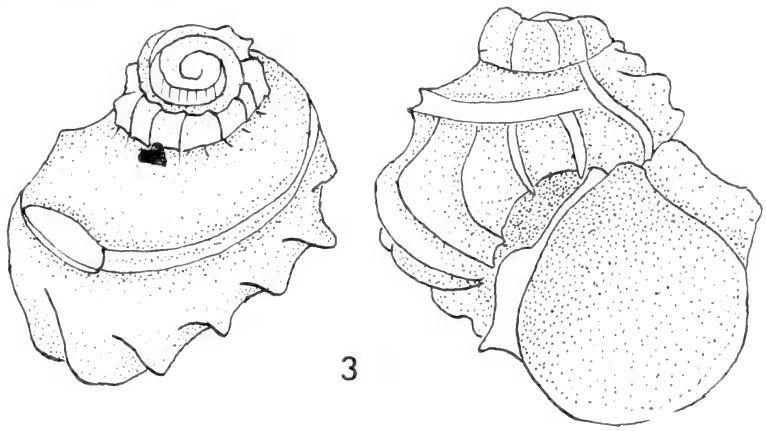


Fig. 3. *Schismope iota* Finlay. Holotype TM-693: height 0.85mm.

Family **FISSURELLIDAE**

Tugali Gray in Dieffenbach, 1843

Tugali pliocenica Finlay, 1926

1926. *Tugali pliocenica* Finlay, Trans. Proc. N.Z. Inst. 56: 227, pl. 59, figs. 1-5; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 173: 37.

TYPE LOCALITY: Castlecliff blue clays (Castlecliffian), [L.Pleistocene].

Type material: AIM No.TM-783. Holotype: length 18.0 mm, width 11.0 mm, height 6.2 mm. Two paratypes 22.5 mm and 17.0 mm in length.

The holotype has *c.* 55 radial ribs and the smallest paratype *c.* 61 ribs.

Tugali navicula Finlay, 1926

1926. *Tugali navicula* Finlay, Trans. Proc. N.Z. Inst. 56: 227, pl. 59, figs. 6-9; Powell & Bartrum, 1929, Trans. Proc. N.Z. Inst. 60: 412; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 173: 37.

TYPE LOCALITY: Target Gully "shell-bed" (Awamoan) [L. Miocene].

Type material: AIM No. TM-782. Holotype: length 17.5 mm, width 9.6 mm, height 4.5 mm. Two paratypes 25.2 mm and 17.7 mm in length.

The holotype is a young and greatly depressed specimen with *c.* 42 radial ribs. The largest senile paratype is far more elevated and has *c.* 53 ribs.

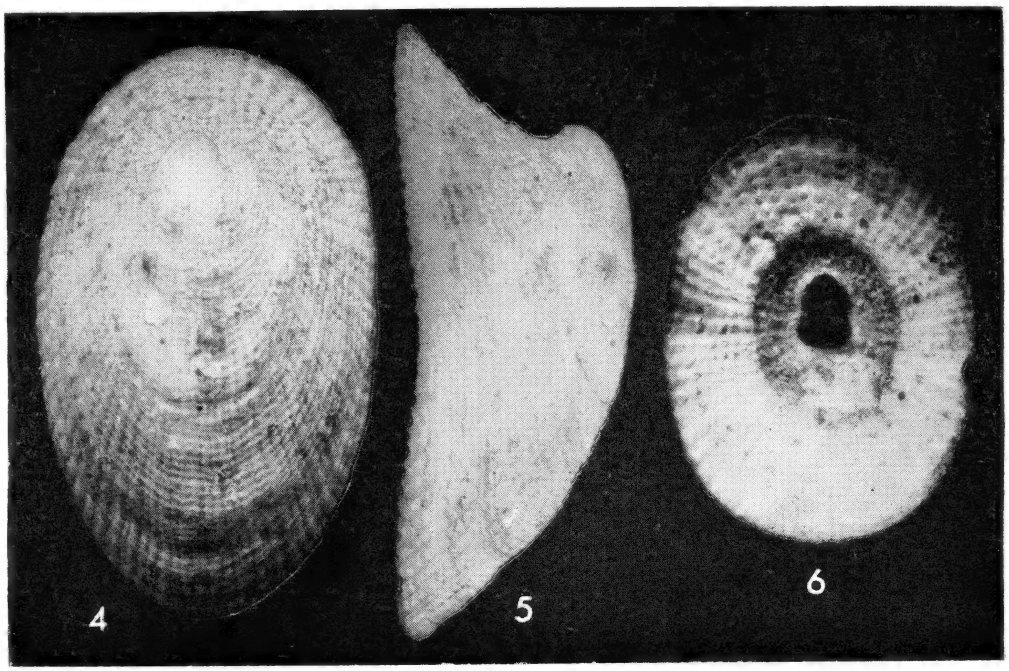
Tugali colvillensis Finlay, [1927] (Figs. 4, 5)

1926. *Tugali colvillensis* Iredale & Finlay MS., Trans. Proc. N.Z. Inst. 56: 227 *(nom. nud.).*
1927. *Tugali colvillensis* Finlay, Trans. Proc. N..Z Inst. 57: 345.

TYPE LOCALITY: Hauraki Gulf, dredged in 20 - 25 fathoms (37 - 46 m), near Cape Colville.

Type material: AIM No.TM-781. Holotype: length 21.8 mm, width 13.0 mm, height 8.4 mm. One paratype, length 14.5 mm, width 8.4 mm, height 5.0 mm.

The holotype has *c.* 73 radial ribs and the paratype *c.* 55 ribs.



Figs. 4-6. 4, 5. *Tugali colvillensis* Finlay. Holotype TM-781: length 21.8mm. 4. Dorsal view. 5. Lateral view. 6. *Monodilepas otagoensis* Finlay. Paratype: length 8.2mm.

Montfortula Iredale, 1915

Montfortula chathamensis Finlay, 1928

1928. *Montfortula chathamensis* Finlay, Trans. Proc. N.Z. Inst. 59: 235, pl. 41, figs. 34, 35.
1971. *Montfortula rugosa* (Quoy & Gaimard), Dell, Rec. Dom. Mus. 750: 37.

TYPE LOCALITY: Chatham Islands.

Type material: AIM No.TM-487. Holotype: length 13.7 mm, width 10.5 mm, height 6.5 mm. Two paratypes 12.1 mm and 7.0 mm in length (very worn).

The holotype has 37 primary radial ribs, the largest paratype 42 and the smallest paratype 32 ribs. According to Dell (1971), *M. chathamensis* is a synonym of *M. rugosa* (Quoy & Gaimard).

Emarginula Lamarck, 1801

Emarginula striatula valentior Finlay, 1928

1928. *Emarginula striatula valentior* Finlay, Trans. Proc. N.Z. Inst. 59: 235, pl. 42, figs. 56, 57.
1955. *Emarginula striatula* (Quoy & Gaimard), Powell, Cape Exped. Ser. Bull. 15: 48.

TYPE LOCALITY: Chatham Islands.

Type material: AIM No.TM-261. Holotype: length 21.3 m, width 16.0 mm, height 11.5 mm.

The holotype has 69 radial riblets. The subspecies has been merged with *Emarginula striatula* (Quoy & Gaimard), by Powell (1955).

Monodilepas Finlay, [1927]

Monodilepas skinneri Finlay, 1928

1928. *Monodilepas skinneri* Finlay, Trans. Proc. N.Z. Inst. 59: 236, pl. 43, fig. 59.
1953. *Monodilepas monilifera skinneri* Finlay, Dell, Trans. R. Soc. N.Z. 81: 150, pl. 14, fig. 1, textfigs. B. 7-9 (figd. holotype).

TYPE LOCALITY: Chatham Islands.

Type material: AIM No.TM-486. Holotype: length 21.7 mm, width 14.0 mm, height 5.3 mm (Worn).

The holotype has *c.* 96 radial ribs. The species has been illustrated and reduced to a subspecies of *M.monilifera* (Hutton, 1873) by Dell (1953).

Monodilepas otagoensis Finlay, 1930 (Fig. 6)

1930. *Monodilepas otagoensis* Finlay, Trans. Proc. N.Z. Inst. 61: 222, pl. 42, fig. 6; Dell, 1953, Trans. R. Soc. N.Z. 81: 151, pl. 14, fig. 2, textfigs. B. 10-12.

TYPE LOCALITY: 10 miles E.N.E. of Otago Heads, in 50 fathoms (91.5 m).

Type material: AIM No.TM-485. Holotype: length 10.0 mm, width 8.1 mm, height 2.2 mm. Three paratypes, length 8.2 mm, width 6.0 mm; length 7.2 mm, width 5.9 mm; length 4.5 mm, width 3.7 mm.

The type specimens are all young and unusually broad. The largest paratype is the least immature and consequently more slender than the holotype. The length: width ratio index is only 72% and the radial ribs number 56 as compared with 80 in the holotype. These features are within the range of variation of *M.monilifera* (Hutton), as given by Dell (1953), and *M.otagoensis* appears to be only a developmental form of that species.

Monodilepas diemenensis Finlay, 1930

1930. *Monodilepas diemenensis* Finlay, Trans. Proc. N.Z. Inst. 61: 222; Dell, 1953, Trans. R. Soc. N.Z. 81: 150, pl. 14, fig. 4, textfigs. B. 4-6.

TYPE LOCALITY: Cape Maria van Diemen.

Type material: AIM No.TM-484. Holotype: length 13.2 mm, width 9.6 mm, height 3.6 mm. (very worn).

The holotype has been illustrated by Dell (1953) but the cited dimensions, i.e. 9.0 mm x 7.0 mm are incorrect. Finlay's original dimensions are very close to the actual measurements of the holotype.

Scutus Montfort, 1810

Scutus petrafixus Finlay, 1930

1930. *Scutus petrafixus* Finlay, Trans. Proc. N.Z. Inst. 61: 54, pl. 2, fig. 23; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 173: 37.

TYPE LOCALITY: Oamaru limestone, (Ototaran) [= ? Runangan, U. Eocene].

Type material: AIM No.TM-707. Holotype: length 50.0 mm, width 34.6 mm (incomplete).

The holotype is embedded in matrix and the posterior margin has been sectioned off. The apex is 17.0 mm from the anterior shell-margin.

Family **TROCHIDAE**

Thoristella Iredale, 1915

Thoristella chathamensis benthicola Finlay, [1927] (Fig. 7)

1925. *Thoristella (chathamensis) benthicola* Finlay, Ged. Verb. Verh. geol. Mijnb. Gen. Ned. & Kolon. 8: 170 *(nom. nud.)*.

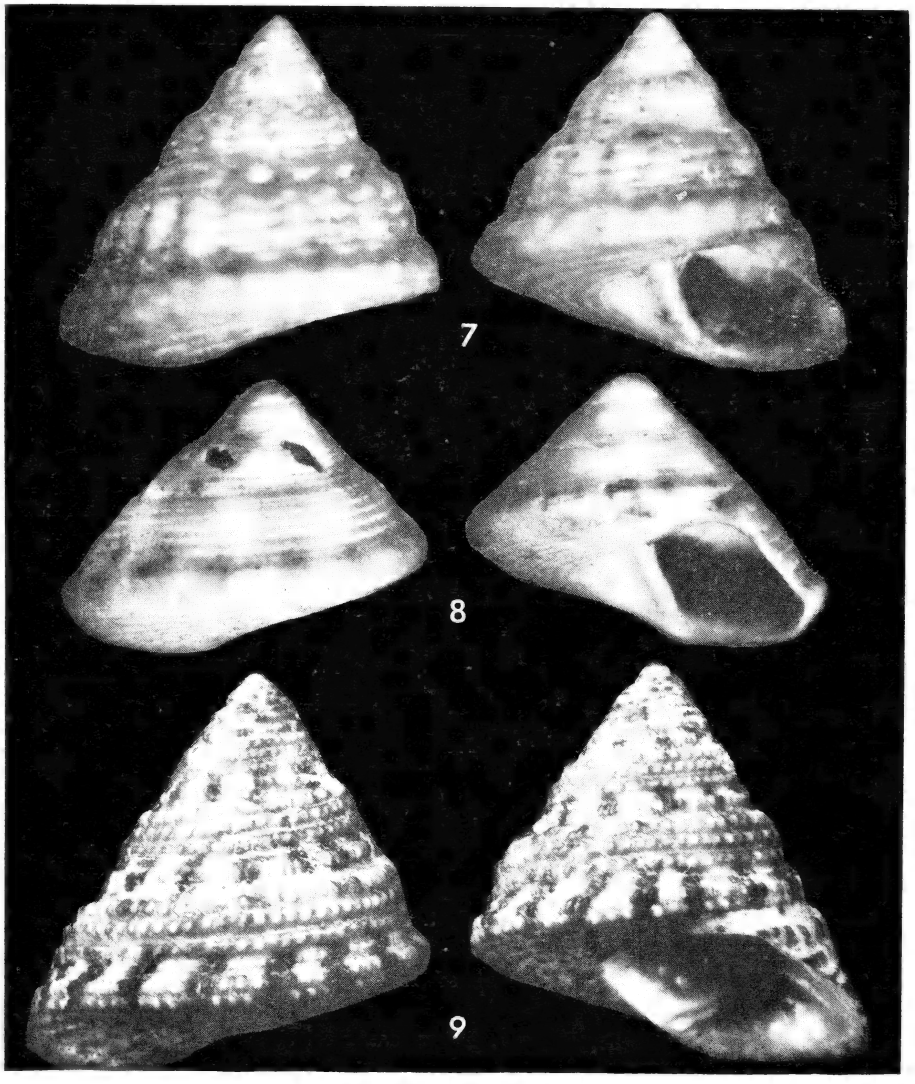
1925. *Thoristella (opressa) benthicola* Finlay, Ged. Verb. Vehr. Mijnb. Gen. Ned. & Kolon. 8: 170 *(nom. nud.)*.

1927. *Thoristella (chathamensis) benthicola* Finlay, Trans. Proc. N.Z. Inst. 57: 350, pl. 18, figs. 7-10; Powell, 1937, Shellf. N.Z., p. 63.

TYPE LOCALITY: Dredged off Otago Heads, in 60 fathoms (110 m).

Type material: AIM No.TM-764.. Holotype: height 6.5 mm, width 7.1 mm. One paratype, height 6.2 mm, width 6.8 mm (immature specimen).

The types are beach-worn specimens. Between the spiral cords are minute, close-set and oblique axial riblets which become finer and slightly arcuate between the basal cords. The holotype has 15 axial ribs on the body whorl and 16 on the penultimate whorl, and the paratype 18 and 17 respectively.



Figs. 7-9. 7. *Thoristella chathamensis benthicola* Finlay. Holotype TM-764: height 6.5mm. 8. *T. chathamensis fossilis* Finlay. Holotype TM-766: height 3.9mm. 9. *Paraclanculus peccatus* Finlay. Holotype TM-584: height 11.0mm.

Thoristella chathamensis fossilis Finlay, [1927] (Fig. 8)

1925. *Thoristella* [*chathamensis*] *fossilis* Finlay, Ged. Verb. Verh. geol. Mijnb. Gen. Ned. & Kolon. 8: 170 *(nom. nud.)*.

1925. *Thoristella* [*fossilis*] *profossilis* Finlay, Ged. Verb. Verh. geol. Mijnb. Gen. Ned. & Kolon. 8: 170 *(nom. nud.)*.

1927. *Thoristella* [*chathamensis*] *fossilis* Finlay, Trans. Proc. N.Z. Inst. 57: 350, pl. 18, figs. 11-14; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 175: 39.

TYPE LOCALITY: Target Gully Shell bed (Awamoan), [L. Miocene].

Type material: AIM No.TM766. Holotype: height 3.9 mm, width 5.4 mm (4 small holes on dorsal side). Ten paratypes, several fragmented and juvenile.

Finlay (1927a) designated the small specimen figured by him on plate 18, fig. 13, as the holotype, but the given measurements, i.e. height 5.5 mm, width 7.0 mm, are those of a large paratype with a part of the spire whorls missing, and illustrated on plate 18, figs. 11 and 14.

The holotype has moderately smooth spiral cords, but in one broken paratype the spiral cords are divided into small, regular nodules.

Paraclanculus Finlay, [1927]

Paraclanculus peccatus Finlay, [1927] (Fig. 9)

1897. *Trochus (Clanculus) ringens* (Menke), Suter, Proc. Malac. Soc. Lond. 2: 262; Suter, 1913, Man. N.Z. Moll. p. 112, pl. 38, fig. 3 *(non Monodonta ringens* Menke, 1843).

1927. *Paraclanculus peccatus* Finlay, Trans. Proc. N.Z. Inst. 57: 351, pl. 18, fig. 17; Powell, 1937, Shellf. N.Z. p. 63.

TYPE LOCALITY: Tryphena, Great Barrier Island [ex-La Roche].

Type material: AIM No.TM-584. Holotype: height 11.0 mm, width 11.1 mm.

P.peccatus Finlay is the type species of *Paraclanculus* Finlay, 1927, by monotypy.

Zediloma Finlay, [1927]

Zediloma digna Finlay, [1927] (Figs. 10,11)

1781. *"Cochlea lunaris pernigra"* Chemnitz, Syst. Conch. Cab. 5: 228, pl. 185, fig. 1848 (Hab: South Seas) [*non binom.*].

1791. *Turbo nigerrimus* Gmelin, Syst. Nat. ed. 13: 3597 (ref. Chemnitz, *op. cit.*, fig. 1848) [Oceano australi].

1817. *Turbo nigerrimus* Gmelin, Dillwyn, Descr. cat. Rec. shells 2: 816 (South Sea on the coasts of New Zealand).

1913. *Monodonta nigerrima* Gmelin, Suter, Man. N.Z. Moll. p. 114, pl. 38, figs. 5, 5a.

1927. *Zediloma digna* Finlay, Trans. Proc. N.Z. Inst. 57: 353, pl. 18, figs. 24, 25; Clark, 1958, Trans. R. Soc. N.Z. 85: 666, textfig.

TYPE LOCALITY: St. Clair near Dunedin.

Type material: AIM No.TM-870. Holotype: height 21.0 mm, width 22.4 mm. One paratype, height 20.0 mm, width 23.0 mm (depressed spire).

When Finlay (1927a) proposed *Zediloma digna* for the New Zealand species listed by Suter as *nigerrima,* he was under the impression, following Philippi (1845), that *Turbo nigerrimus* Gmelin, was originally described from South America. Chemnitz (1781) described the species from the South Seas and remarked that the specimen illustrated by him originated from Solander (who

accompanied Captain Cook on his voyage to the South Pacific and New Zealand). Philippi *(loc.cit)* proposed the genus *Diloma* for 4 species, i.e. *Trochus melanoloma* Menke (= *Monodonta melanoloma* Menke, 1843), *Turbo aethiops* Gmelin, 1791, *Turbo nigerrimus* Gmelin, 1791 and *Trochus zelandicus* Quoy & Gaimard, 1834, but did not select a type species. He also considered *Trochus araucanus* d'Orbigny, 1840, described from Valparaiso, Chile, to be a new name for *Turbo nigerrimus* Gmelin. Comparison of New Zealand and South American specimens of *Turbo nigerrimus* and *Trochus araucanus* shows the two species to be inseparable.

The type designation for *Diloma* Philippi requires clarification: Herrmannsen's (1847) and Gray's (1847) designations of *Trochus nigerrimus* Gmelin, 1791, as the type of *Diloma* cannot be considered valid, since *Trochus nigerrimus* Gmelin, described from China, is a different species from *Turbo nigerrimus* of Gmelin and Philippi, and belongs to *Tegula* Lesson, 1835, subgenus *Omphalius* Philippi, 1847. The next available, and probably valid type designation is the one by Pilsbry in Tryon (1889) who designated "*M.*[*onodonta*] *nigerrima* (Gmel) Phil." as the type species of *Diloma*. If this type designation is not acceptable on the grounds of ambiguity, then Suter's (1913) type designation of *Turbo nigerrimus* Gmelin, is the next explicit type designation.

Zediloma Finlay, 1927, type species by original designation *Z.digna* Finlay, 1927 = *Turbo nigerrimus* Gmelin, 1791, becomes a synonym of *Diloma* Philippi, 1847.

Zediloma arida Finlay, [1927] (Fig. 12)

1913. *Monodonta coracina* Troschel, Suter, Man. N.Z. Moll. p. 114, pl. 38, fig. 4 (non *Trochus coracinus* Philippi, 1851).

1927. *Zediloma arida* Finlay, Trans. Proc. N.Z. Inst. 57: 353 *(nom. subst. pro Monodonta coracina* Suter, 1913); Clark, 1958, Trans. R. Soc. N.Z. 85: 668, textfigs.

TYPE LOCALITY: Lyttelton Harbour.

Type material: AIM No.TM-869. Finlay's selected "neotype": height 13.0 mm, width 15.4 mm (operculum within). Another, larger specimen in the same vial, has no type status.

Finlay (1927a) proposed *Zediloma arida* as a substitute name for *Monodonta coracina* Suter, and at the same time applied the name to the particular specimen figured by Suter (1915, pl. 38, fig. 4). According to art.72(d) of the Code of ICZN, the actual type of *Zediloma arida* is the specimen figured by Suter *(loc.cit.)*, provided it is still extant. Even if lost, Finlay's neotype designation does not fulfil the qualifying conditions for a neotype selection (art.75(c) and 75(e).

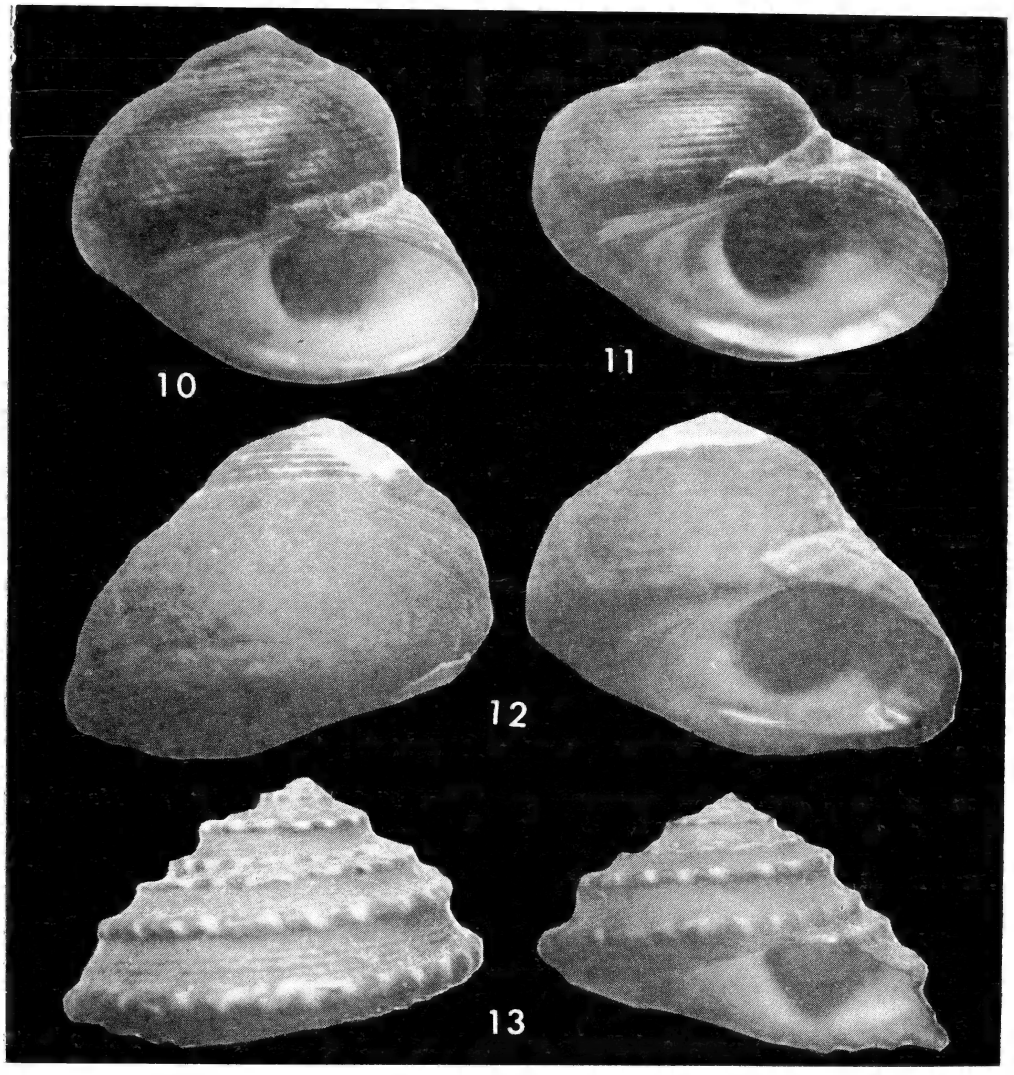
Anisodiloma Finlay, [1927]

Anisodiloma lugubris lenior Finlay, [1927] (Fig. 13)

1927. *Anisodiloma lugubris lenior* Finlay, Trans. Proc. N.Z. Inst. 57: 354; Powell, 1937, Shellf. N.Z. p. 63.

TYPE LOCALITY: Taieri beach, 5 miles south of Taieri River.

Type material: AIM No.TM-34. Holotype: height 10.2 mm, width 14.8 mm.



Figs. 10-13. 10, 11. *Zediloma digna* Finlay. Types TM-870. 10. Holotype: height 21.0mm. 11. Paratype: height 20.0mm. 12. *Z. arida* Finlay. "Neotype" TM-869: height 13.0mm. 13. *Anisodiloma lugubris lenior* Finlay. Holotype TM-34: height 10.2mm.

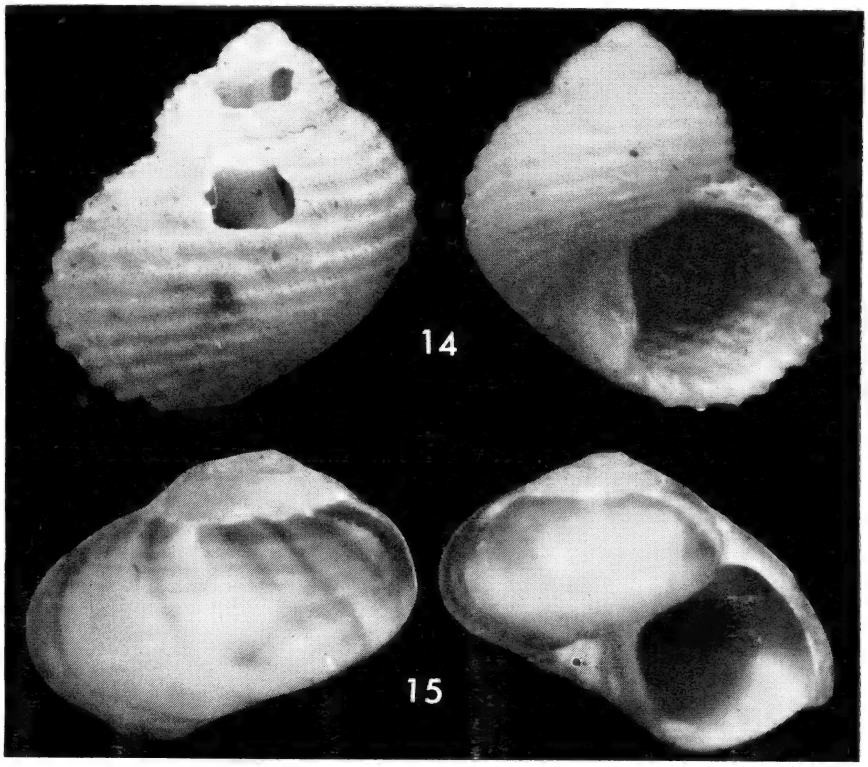
Whorls have 3 nodulose spiral cords and interspaces of cords 4 intermediate spiral threads and oblique axial striae. The subspecies is the southern form of *A.lugubris* (Gmelin, 1971).

Herpetopoma Pilsbry in Tryon, 1889

Herpetopoma mariae Finlay, 1930 (Fig. 14)

1913. *Euchelus baccatus* Menke, Suter, Man. N.Z. Moll. p. 1084 (non *Monodonta baccata* Defrance in Blainville, 1824; nec Menke, 1843).

1930. *Herpetopoma mariae* Finlay, Trans. Proc. N.Z. Inst. 61: 223.



Figs. 14, 15. 14. *Herpetopoma mariae* Finlay. Holotype TM-357: height 10.5mm.
15. *Talopena sublaevis* Finlay. Holotype TM-756: height 2.8mm.

TYPE LOCALITY: Cape Maria van Diemen.

Type material: AIM No.TM-357. Holotype: height 10.5 mm, width 10.0 mm (2 holes on dorsal side at last 2 whorls). One paratype, height 9.3 mm (juvenile, outer lip broken, holed on ventral side of the body whorl).

Talopena Iredale, 1918

Talopena sublaevis Finlay, [1924] (Fig. 15)

1853. *Margarites tessellata* A. Adams, Proc. Zool. Soc. Lond. for 1851: 191.

1924. *Talopena sublaevis* Finlay, Trans. Proc. N.Z. Inst. 55: 520, textfig. 3.

1924. *Cantharidella tesselata (sic)* (A. Adams), Powell, Shellf. N.Z. p. 87.

TYPE LOCALITY: In oyster-scrapings from Bluff [Stewart I.].

Type material: AIM No.TM-756. Holotype: height 2.8 mm, width 3.8 mm.

On the card Finlay wrote in 1930: "a worn juvenile of *Cantharidella tesellata* (= *tessellata).*

Calliostoma Swainson, 1840

Calliostoma suteri Finlay, 1923

1923. *Calliostoma suteri* Finlay, Trans. Proc. N.Z. Inst. 54: 101, pl. 10, figs. 1a-c.

1926. *Calliostoma (Calliotropis) suteri* Finlay, Oliver, Proc. Malac. Soc. Lond. 17: 113.

1927. *Venustas (Mucrinops) suteri* Finlay, Trans. Proc. N.Z. Inst. 57: 361.

1935. *Maurea (Mucrinops) suteri* (Finlay), Laws, Trans. Proc. R. Soc. N.Z. 65: 32.

1966. *Maurea (Mauriella) suteri* (Finlay), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 173: 38.

TYPE LOCALITY: Ardgowan [L.Miocene].

Type material: AIM No.TM-129. Holotype: height 6.8 mm, width 8.2 mm (spire whorls missing). Paratype illustrated on pl. 10, fig. 1b: fragment of body whorl; paratype illustrated on pl. 10, fig. 1c: width 11.0 mm (spire whorls and part of body whorl missing).

Calliostoma suteri fragile Finlay, 1923 (Fig. 16)

1923. *Calliostoma suteri* var. *fragile* Finlay, Trans. Proc. N.Z. Inst. 54: 102, pl. 10, figs. 2a-c.

1926. *Calliostoma (Calliotropis) fragile* Finlay, Oliver, Proc. Malac. Soc. Lond. 17: 113.

1927. *Venustas fragilis* Finlay, Trans. Proc. N.Z. Inst. 57: 361.

1935. *Maurea fragilis* (Finlay), Laws, Trans. Proc. R. Soc. N.Z. 65: 32.

TYPE LOCALITY: Ardgowan [L. Miocene].

Type material: AIM No.TM-130. Holotype: height 10.0 mm, width 10.7 mm. Paratype illustrated on pl. 10, fig. 2b: height 10.6 mm, width 10.8 mm, (part of body whorl missing on ventral side); paratype illustrated on pl. 10, fig. 2c; height 8.7 mm+, width 11.2 mm (spire whorls missing).

The specimen illustrated on pl. 10, fig. 2a and designated by Finlay (1923a) in the plate explanations as the holotype, is present in the collection, but the width is only 10.7 mm and not 15.0 mm as given by Finlay *(loc.cit.)* in the text.

Calliostoma temporemutata Finlay, 1924

1923. *Calliostoma cancellatum* Finlay, Trans. Proc. N.Z. Inst. 54: 102, pl. 10, fig. 3 (non Schepman, 1908).

1924. *Calliostoma temporemuta* Finlay, Trans. Proc. N.Z. Inst. 55: 509, footnote *(nom. subst. pro C. cancellatum* Finlay, 1923).

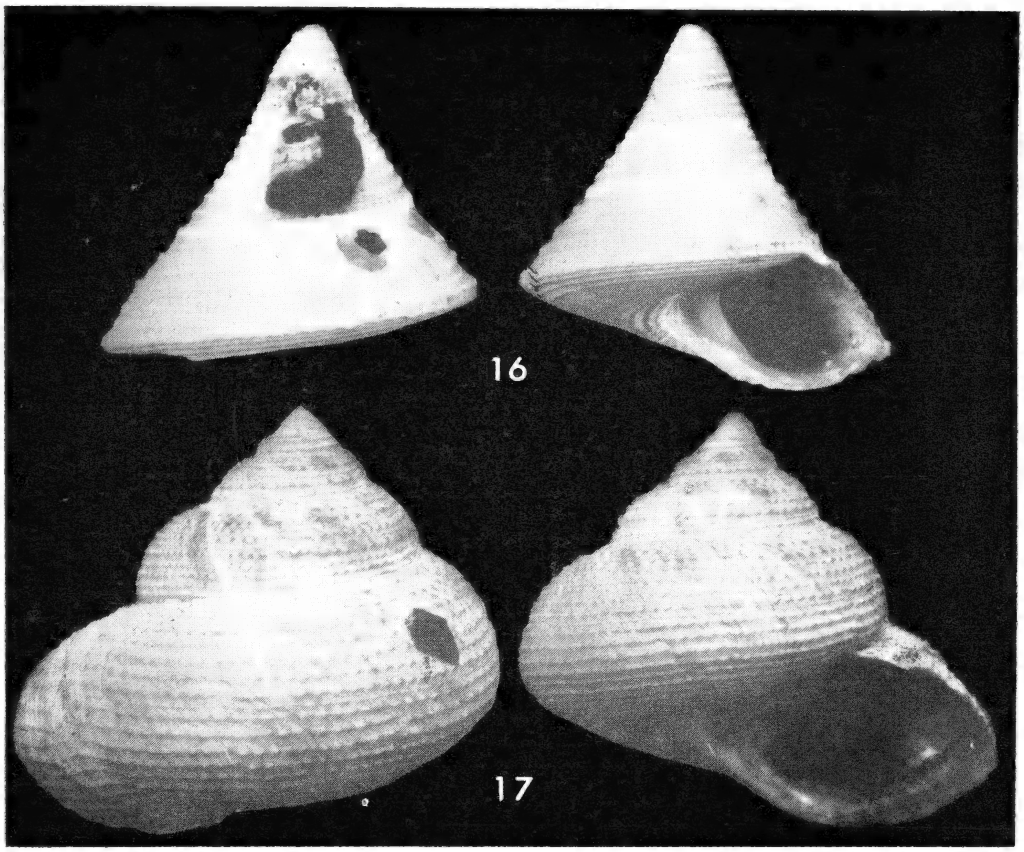
1926. *Calliostoma (Calliotropis) temporemuta* Finlay, Oliver, Proc. Malac. Soc. Lond. 17: 114.

1927. *Fautor temporemutata* (Finlay), Trans. Proc. N.Z. Inst. 57: 492 (emend.).

1935. *Fautor temporemutatus* (Finlay), Laws, Trans. Proc. R. Soc. N.Z. 65: 31, pl. 5, fig. 4; Fleming, 1966, N.Z. Dep. Sci. Ind. Res. Bull. 173: 39.

TYPE LOCALITY: Ardgowan [L. Miocene].

Type material: AIM No.TM-128. Holotype: height 5.4 m +, width 6.0 mm (juvenile, spire whorls and part of penultimate whorl missing).



Figs. 16, 17. 16. *Calliostoma suteri fragile* Finlay. Holotype TM-130: height 10.0mm. 17. *Venustas punctulata urbanior* Finlay. Holotype TM-824: height 26.8mm.

Venustas Finlay, [1927] [= **Maurea** Oliver, 1926]

Venustas punctulata urbanior Finlay, [1927] (Fig. 17)

1926. *Calliostoma (Mauriella) punctulatum* subsp. *stewartianum* Oliver, Proc. Malac. Soc. Lond. 17: 109, pl. 10, fig. 1 (Foveaux Str., Stewart I.) [30 December, 1926].

1927. *Venustas punctulata urbanior* Finlay, Trans. Proc. N.Z. Inst. 57: 361, pl. 18, fig. 27.

1950. *Venustas punctulata urbanior* Finlay, Dell, Dom. Mus. Rec. Zool. 1: 47; Powell, 1955, Cape Exp. Ser. Bull. 15: 55.

1957. *Maurea punctulata stewartiana* (Oliver), Powell, Shells N.Z. p. 88.

1966. *Maurea (Mauriella) punctulata stewartiana* (Oliver), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 173: 38.

TYPE LOCALITY: Foveaux Strait, in 20 fathoms (37 m).

Type material: AIM No.TM-824. Holotype: height 26.8 mm, width 29.3 mm (operculum within). One paratype, height 22.4 mm, width 25.7 mm.

Venustas cunninghami regifica Finlay, 1927

1795. *"Trochus selectus"* Chemnitz, Syst. Conch. Cab. 11: 168, pl. 196, figs. 1896, 1897 (Coasts of New Zealand) [*non binom.*].

1817. *Trochus selectus* Dillwyn, Desc. cat. Rec. shells 2: 801 (ref. Chemnitz, *op. cit.*); Wood, 1825, Ind. Test, p. 140, pl. 29, fig. 101a.

1834. *Trochus cunninghami* Gray in Griffiths & Pidgeon, Anim. Kingd. Bar. Cuv. Moll. Rad. 12: 600, pl. 1, fig. 7.

1846. *Trochus torquatus* Anton in Philippi, Syst. Conch. Cab. ed. 2, 2 (3): 261, pl. 38, fig. 13; Philippi, 1849, Zeit. Malakozool. 5: 126 (non H. C. Lea, 1846).

1913. *Calliostoma selectum* Chemnitz, Suter, Man. N.Z. Moll. p. 146, pl. 40, fig. 4; Finlay, 1924, Trans. Proc. N.Z. Inst. 55: 518.

1926. *Calliostoma (Calliotropis) pagoda* Oliver, Proc. Malac. Soc. Lond. 17: 112, pl. 10, fig. 4.

1927. *Venustas cunninghami regifica* Finlay, Trans. Proc. N.Z. Inst. 57: 485, pl. 24, figs. 9, 10.

1950. *Venustas cunninghami cunninghami* (Griffiths & Pidgeon), Dell, Dom. Mus. Rec. Zool. 1: 53.

1950. *Venustas cunninghami pagoda* (Oliver), Dell, Dom. Mus. Rec. Zool. 1: 53.

1966. *Maurea (Calotropis) cunninghami* (Griffiths & Pidgeon), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 173: 38.

TYPE LOCALITY: Off Otago Heads, in 30 fathoms (55 m).

Type material: AIM No.TM-823. Holotype: height 56.8 mm, width 64.1 mm.

Oliver (1926) and Finlay (1927a), rejected the name *selectus* Chemnitz on the grounds of not being a binomial, but the specific name was twice validated prior to the introduction of *Trochus cunninghami* into literature. In introducing *regifica* for the form with roundly angled sides, Finlay (1927b) was anticipated by Oliver *(loc.cit.)* with the description of *Calliostoma pagoda*. Dell (1950) has shown that both forms are sympatric at Kapiti Islands, and *Venustas cunninghami regifica* Finlay, is considered to be a synonym of the chronologically prior *Maurea selecta* (Dillwyn, 1817).

Family **TURBINIDAE**

Argalista Iredale, 1915

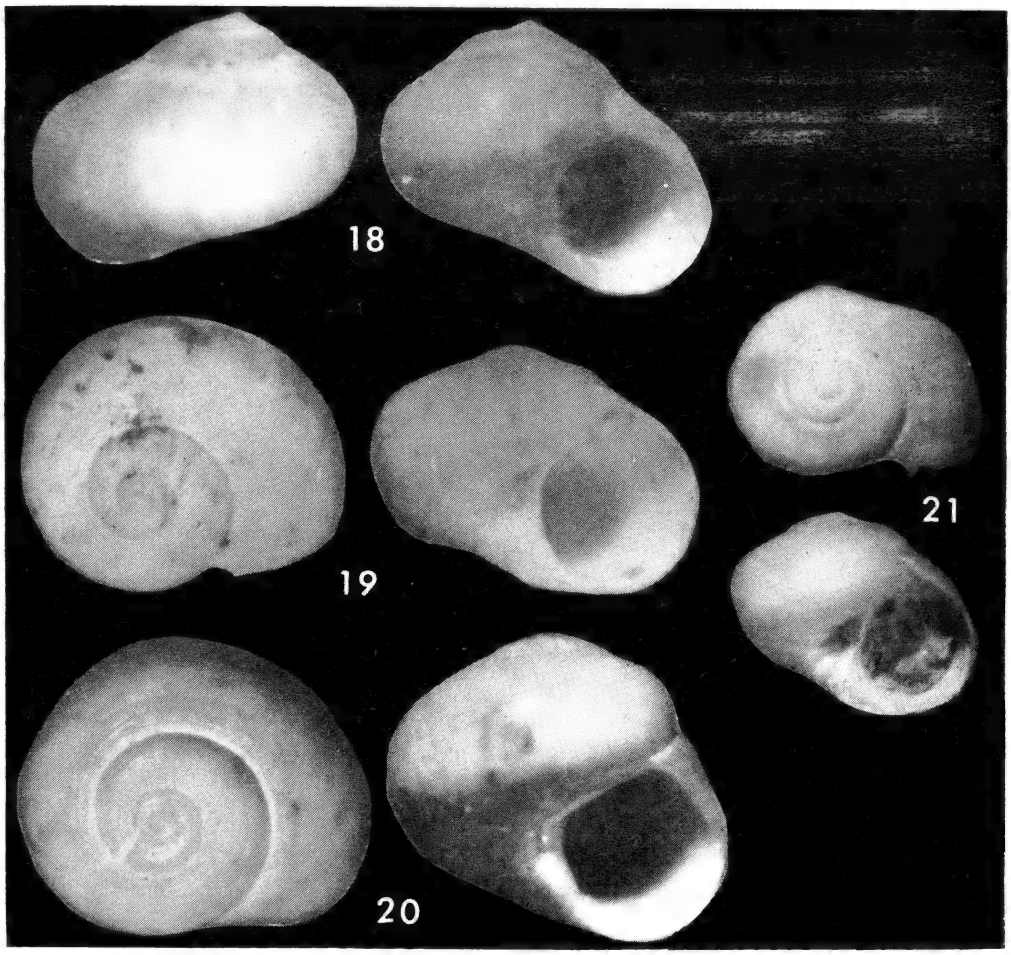
Argalista nana Finlay, 1930 (Fig. 18)

1930. *Argalista nana* Finlay, Trans. Proc. N.Z. Inst. 61: 223; Powell, 1957, Shells N.Z. p. 90.

TYPE LOCALITY: Awanui Bay, in 12 fathoms (22 m).

Type material: AIM No.TM-44. Holotype: height 1.7 mm, width 2.4 mm. Thirteen paratypes (beach-worn specimens).

Finlay's measurements given for the holotype, i.e. height 9.0 mm, width 2.5 mm, are erroneous. The type is slightly wider than high and Finlay's measurements are out of proportion to the ratio of height : width. The penultimate whorl of the holotype has *c.* 8 spiral threads, and the body whorl *c.*40; the umbilicus is not almost filled up as stated by Finlay, but has a deep, crescent-shaped fissure within.



Figs. 18-21. 18. *Argalista nana* Finlay. Holotype TM-44: height 1.7mm. 19. *A. proumbilicata* Finlay. Holotype TM-47: height 1.7mm. 20. *A. impervia* Finlay. Holotype TM-40: height 2.2mm. 21. *A. kaiparaensis* Finlay. Holotype TM-41: height 1.0mm.

Finlay's species is a synonym of *Homalopoma (Argalista) fluctuata* (Hutton, 1883).

Argalista proumbilicata Finlay, 1930 (Fig. 19)

1930. *Argalista proumbilicata* Finlay, Trans. Proc. N.Z. Inst. 61: 56, pl. 2, figs. 20-22.

1966. *Homalopoma (Argalista) proumbilicata* (Finlay), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 173: 40.

TYPE LOCALITY: Target Gully shell-bed (Awamoan) [L. Miocene].

Type material: AIM No.TM-47. Holotype: height 1.7 mm, width 2.4 mm. Paratype illustrated on pl. 2, fig. 22, width 1.9 mm, plus 17 other paratypes.

Argalista kaiparaensis Finlay, 1930 (Fig. 21)

1930. *Argalista kaiparaensis* Finlay, Trans. Proc. N.Z. Inst. 61: 56.

1966. *Homalopoma (Argalista) kaiparaensis* (Finlay), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 174: 40.

TYPE LOCALITY: Pakaurangi Point, Kaipara (Hutchinsonian) [= Otaian, L. Miocene].

Type material: AIM No.TM-41. Holotype: height 1.0 mm, width 1.5 mm (hole on dorsal side of body whorl).

Argalista impervia Finlay, 1930 (Fig. 20)

1930. *Argalista impervia* Finlay, Trans. Proc. N.Z. Inst. 61: 57.

1966. *Homalopoma (Argalista) impervia* (Finlay), Fleming, N.Z. Dep. Sci. Ind. Res. Bull. 173: 40.

TYPE LOCALITY: Target Gully shell-bed (Awamoan) [L. Miocene].

Type material: AIM No.TM-40. Holotype: height 2.2 mm, width 2.9 mm. Seventy-five paratypes.

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A KERMADEC ISLANDS CONUS (MOLLUSCA: GASTROPODA) FOUND LIVING IN NORTHERN NEW ZEALAND WATERS

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Abstract. Records of *Conus* spp. in New Zealand are given, including authentic recent records of living specimens.

The genus *Conus* is seldom found outside of tropical and subtropical waters, and until now there was no authentic record of a species of that genus, actually found living, in situ, in New Zealand waters.

Discounting records from early general works on conchology, in which some thirteen species of common Indo-Pacific cones were credited, undoubtedly erroneously, as occurring also in New Zealand, we are left with only three authentic New Zealand records.

(1) *Conus marmoreus* Linnaeus, 1758. A half-grown well preserved example, said to have been picked up alive at Farewell Spit, Cook Strait, by a lighthouse keeper, early in 1917 (Mestayer 1918: 102).

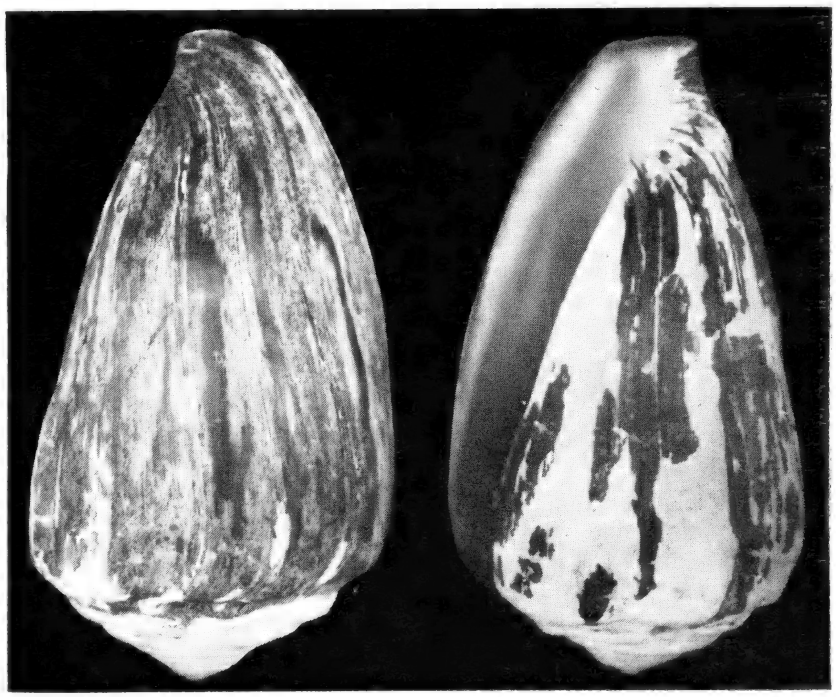

Fig. 1. *Conus kermadecensis* Iredale, Parengarenga Hbr.

Rec. Auckland Inst. Mus. 9: 249-251 December 15th 1972

(2) *Conus* sp. A small very imperfect empty shell, in too poor condition for specific determination, was obtained by dredging in 440 fathoms north of the Three Kings Islands. The shell bears some resemblance to *Conus (Kermasprella) raoulensis* Powell, 1958 (Powell 1958:83, Crozier 1966:48).

(3) *Conus kermadecensis* Iredale, 1912. A single extra large example of this species (Fig. 1) was found living on a low-tidal sandbank at the entrance to the Te Kao Channel, Parengarenga Harbour, Northland by Mrs M. E. Armiger, January, 1972.

Subsequent visits to the Te Kao sandbank by Mrs Armiger and several members of the Auckland Museum Conchology Section have not resulted in the finding of further examples of this Kermadec cone.

The Te Kao specimen could owe its presence there to an earlier chance spat fall, possibly dating back to the time of the temporary invasion of east coast Northland localities by the large Indo-Pacific swimming crab, *Scylla serrata* (Forskal, 1775). The localities and dates for these crab occurrences are — Takou Estuary, south of Whangaroa, 1962-1964; Price's Point, Awanui Harbour, May 15th 1964; Te Kao Landing, Parengarenga Harbour, April, 1964; Russell Wharf, Bay of Islands, Cooper's Beach and Tokerau Beach, Doubtless Bay, 1964 (Dell 1964: 60). Since then there have been no further records of this crab in New Zealand waters.

Time alone will decide if the *Conus kermadecensis* record is just a chance occurrence, or if another species has been added to our fauna.

Conus kermadecensis Iredale, 1912

1912 *Conus kermadecensis* Iredale, Proc. Malac. Soc., Lond. 10: 227, pl. 9, figs. 15, 16.

1915 *Conus kermadecensis* Iredale, Oliver, Trans. Proc. N.Z. Inst. 47: 541.

Records: Sunday Island, Kermadec Islands (type). Meyer Island, Kermadec Islands, living on rocks just below low-water mark (Oliver). New Zealand, low tide on sandbank, entrance to Te Kao Channel, Parengarenga Harbour (Mrs M. E. Armiger, January, 1972).

The Parengarenga specimen is in the collection of Mrs Armiger of Whangarei. It is a fully grown shell, larger than the holotype or any example subsequently known, but unmistakably *kermadecensis*. Although the dark olive-brown periostracum is largely weathered away, and the exposed shell surface eroded, traces of the characteristic coloration, which is orange, with a broad median band of white, still remain near the inner-lip. The interior of the aperture is pale bluish. Although the Parengarenga shell was taken alive, the animal became so retracted after preservation that it could not be removed for examination without damage to the shell.

Height 74.5 mm, width 41.0 mm. Parengarenga Harbour.

Height 55.0 mm, width 29.0 mm. Holotype. Sunday Island, Kermadecs.

Height 47.0 mm, width 26.5 mm. Meyer Island, Kermadecs.

NOTE

Since the above was written a small colony of five individuals was observed at low tide, on Zostera, less than a mile north of the Te Kao sandbank, in late March, 1972. The finder, Master A. Wilson, of Whangarei, generously donated one of the specimens to the Auckland Museum. It is a three-quarters grown example (33 mm x 21 mm), in perfect condition, with the periostracum intact. The question arises — is this immature example the result of a subsequent spatfall, or is the species now breeding in the area?

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TRICHOPTERA OF THE AUCKLAND ISLANDS

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AUCKLAND INSTITUTE AND MUSEUM

Abstract. Of four species of Trichoptera now known from the Auckland Is., two are described as new in the genera *Costachorema* and *Tiphobiosis* (Family Rhyacophilidae), and two are recorded in the genera *Oxyethira* and *Paroxyethira* (Family Hydroptilidae), the last being an undetermined species known only from larval-pupal cases.

Four species of two families of Trichoptera have been collected in the Auckland Is. Two of these appear to be widespread within this island group, a third species is represented only by a unique adult and a fourth by a few larval-pupal cases taken in one stream.

Specimens examined are from the collections of the Bernice P. Bishop Museum, Honolulu (B.P.B.M.), Dominion Museum, Wellington (D.M.), Entomology Division, Nelson (E.D.), and Canterbury Museum, Christchurch (C.M.). A representative series has been lodged in the Auckland Museum.

Family RHYACOPHILIDAE

Genus **Costachorema** McFarlane, 1939

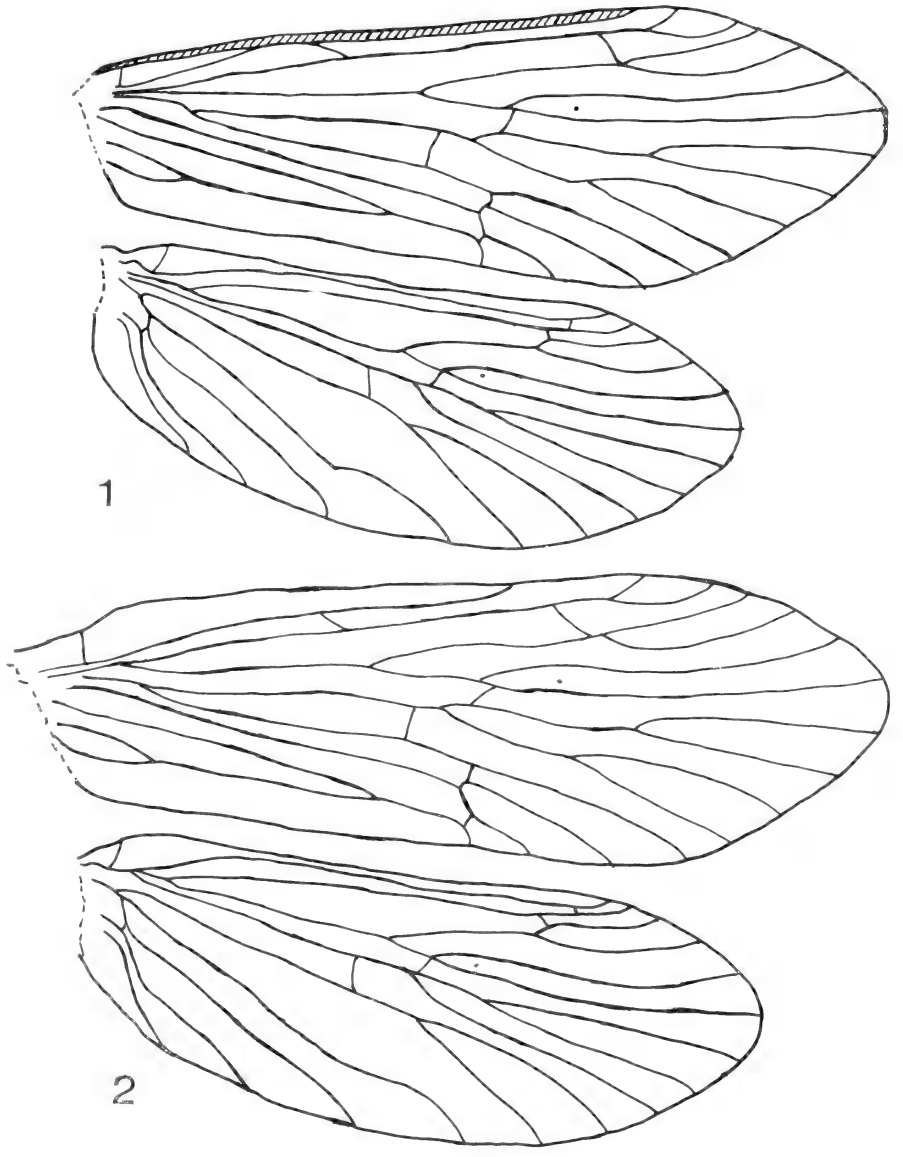
Costachorema notoptera Wise, sp.n. (Figs. 1 - 16)

A medium-sized species with pale brown wings longer than body, hairs of head all dark brown.

Wings, ♂♀ (Figs. 1-2). Venation normal for genus.

Abdomen and genitalia, ♂ (Figs. 3-7). Segment VII with ventral process; dorsal posterior margin of VIII straight, membranous or lightly sclerotised mid-dorsally. Segment IX membranous dorsally. Segment X (dorsal plate) membranous with two apical concavities distally. Superior appendages rounded apically, a pair of long elongate processes beneath them, each process expanded apically with a basal dorsal stout process, an adjacent short narrow process internally. Inferior appendages stout, two-jointed, basal joint somewhat rounded apically, distal joint leaf-like, approximately half length of basal. Aedeagus as figured (Figs. 6-7).

Abdomen and genitalia, ♀ (Figs. 8-11). Abdomen V with minute ventral tooth in lateral view; tooth broad, rounded in ventral view; line of tooth extending as oval line on sternite. Abd. VI with short ventral tooth; VII without tooth. Abd. VIII strongly chitinised, annular about abdomen; sternite extending posteriorly to upturned distal point, the posterior extension supporting a fleshy lobe. Beyond Abd. VIII, a large dorsal chitinised shield (Abd. IX?), with a fleshy apical lobe (Abd. X?) bearing a dorso-lateral pair of tubercles and a pair of minute distal tubercles.

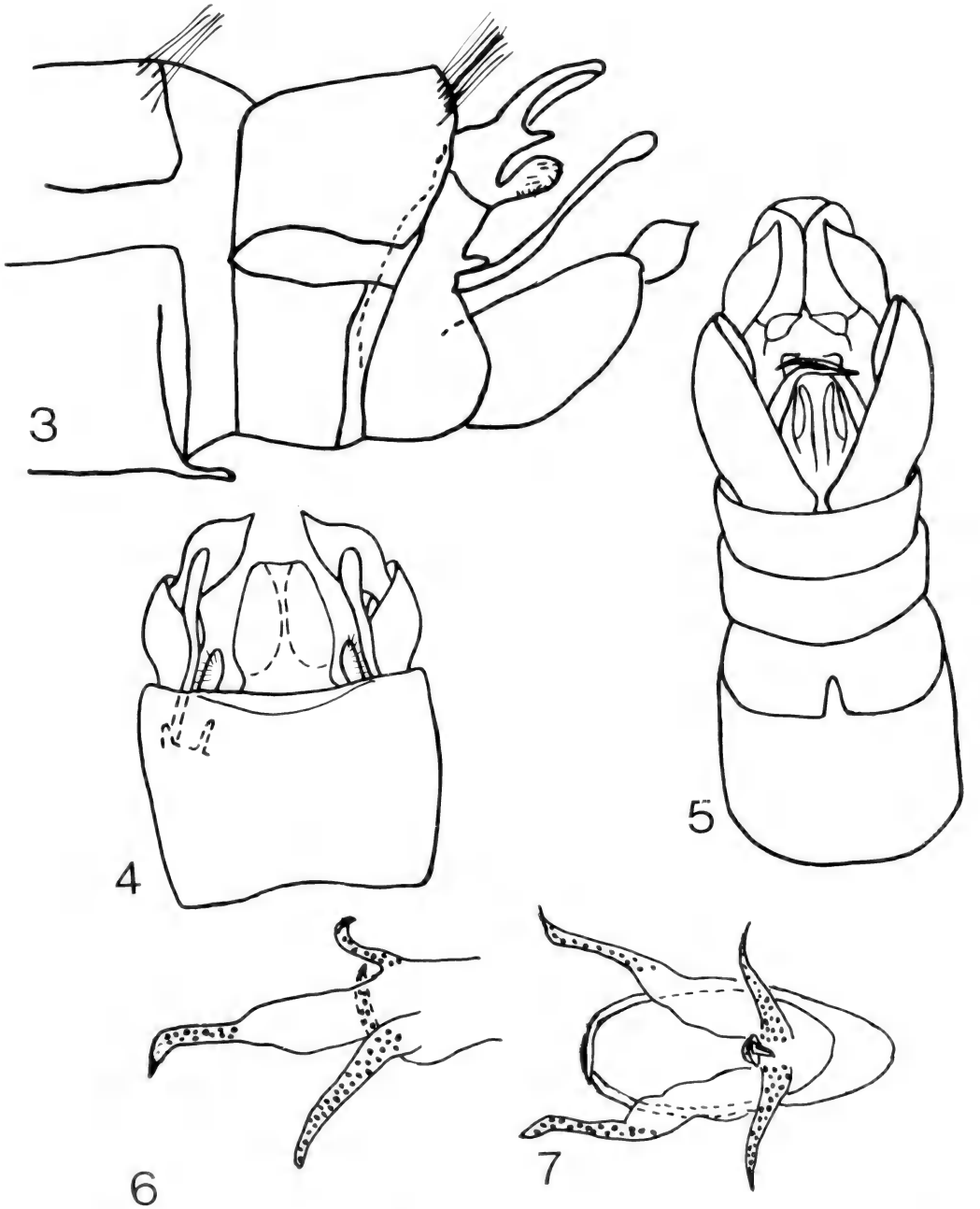


Figs. 1, 2. *Costachorema notoptera* Wise, n. sp. 1. ♂ wings. 2. ♀ wings.

Measurements. Anterior wing, ♂ ♂ 10.5 - 11.25 mm, ♀ ♀ 12.5 - 13 mm; head + body, ♂ ♂ 8.25-8.5 mm, ♀ ♀ 9.5-10 mm.

LARVA (Figs. 12-16)

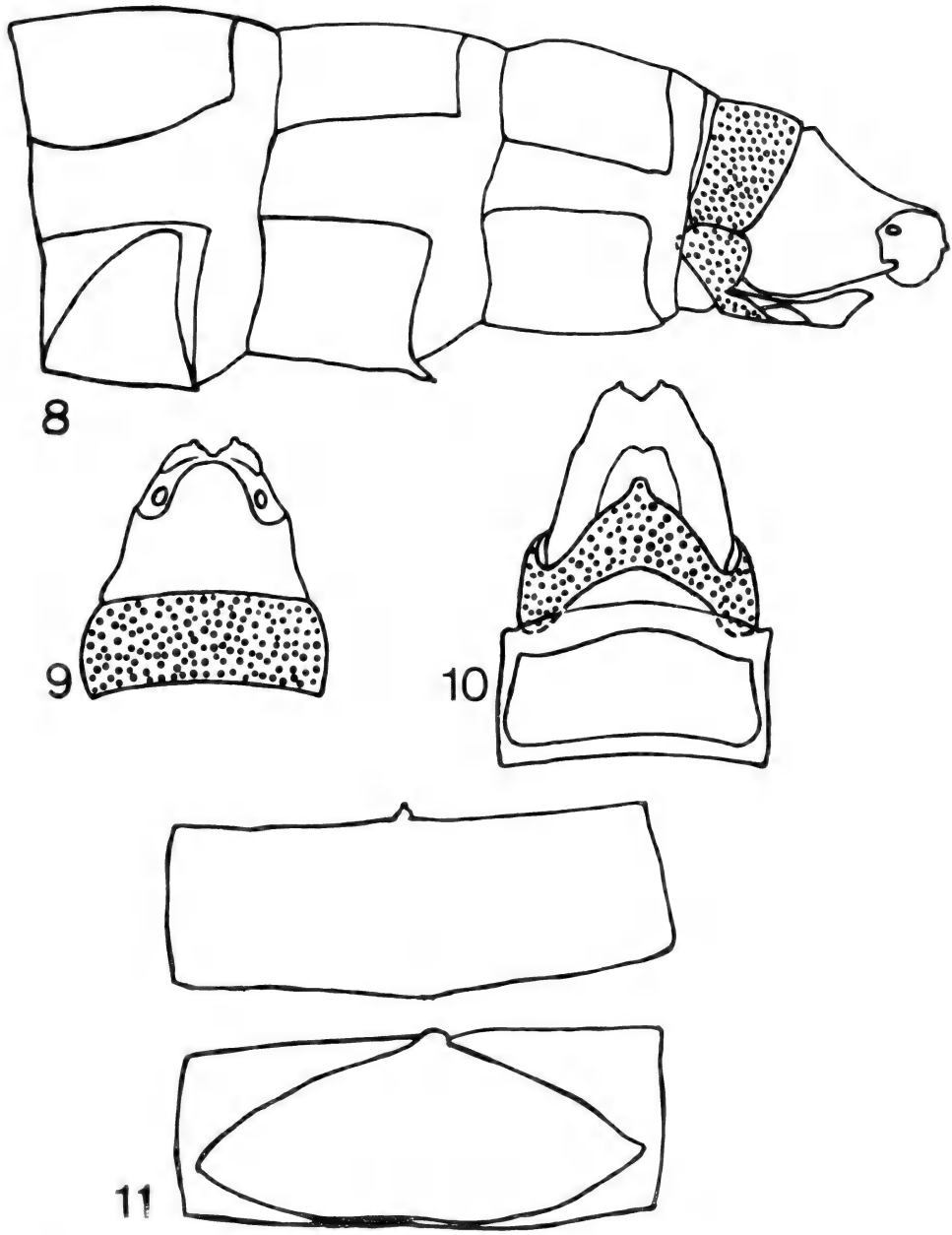
Pale purple; head light brown, with darker median longitudinal band and latero-ventral posterior patches, dark median band containing several pale spots; pronotum pale yellowish-brown with three darker dorsal patches posteriorly, each patch containing paler spots; legs pale yellowish-brown.



Figs. 3-7. *Costachorema notoptera* Wise, n. sp. 3. ♂ genitalia, lateral. 4. ♂ genitalia, dorsal. 5. ♂ genitalia, ventral. 6. Aedeagus, lateral. 7. Aedeagus, dorsal.

Prothorax (Figs. 13-14). Pronotum broader than long. Prosternum consisting of median element, rounded posteriorly, with two lateral triangular pieces.

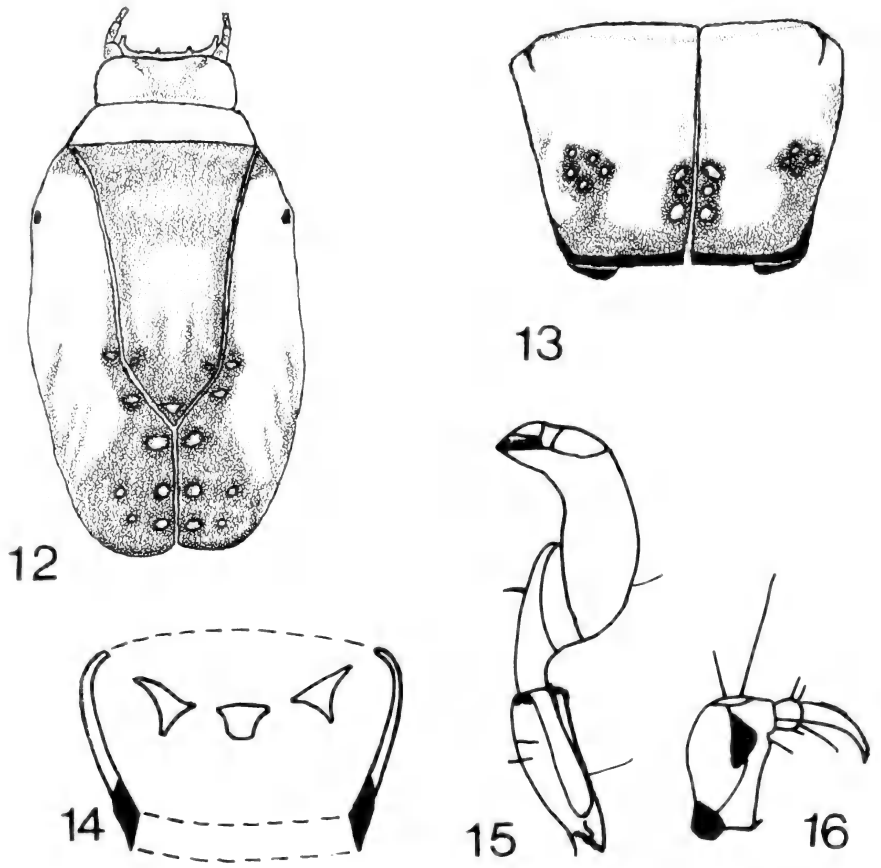
Prothoracic legs (Fig. 15). Massive.



Figs. 8-11. *Costachorema notoptera* Wise, n. sp. 8. ♀ abdomen and genitalia, lateral. 9. ♀ genitalia, dorsal. 10. ♀ genitalia, ventral. 11. ♀ abdominal segments V (bottom) and VI (top), ventral view.

Pygopods (Fig. 16). Massive.

Measurements. Length, 25 mm; head, length 2 mm, width 1.25 mm; pronotum, length 1 mm, width 1.4 mm.



Figs. 12-16. *Costachorema notoptera* Wise, n. sp. Larva. 12. Head, dorsal. 13. Pronotum. 14. Prothorax, ventral. 15. Prothoracic leg. 16. Pygopod.

Specimens examined. AUCKLAND IS. Holotype ♂. S.E. Enderby I: ex pond stream, 10.30 p.m.-12 midnight, 17.I.1963, K. A. J. Wise. Allotype ♀. Same data as holotype. Both lodged in Auckland Museum, Auckland, N.Z.

Paratypes. (B.P.B.M.) S.E. Enderby I: ex pond stream, 10.30 p.m.-12 midnight, 17.I.1963, (16), Wise. (E.D.) Auckland I: Ranui Cove, 4.I.1963, (1); Ranui Stream, swept, 12.I.1963, (1); L. J. Dumbleton. (C.M.) Adams I: Fairchild's Garden, in stream gut at night, 28.I.1966, (1), P. M. Johns.

Immatures. (B.P.B.M.) Enderby I: ex stream from biggest pond, 2.I.1963, 6 larvae, 6 pupal cases; Sandy Bay, ex stream near boatshed, 16.I.1963, 1 larva; Wise; 31.XII. 1962, 1 larva, 6 pupal cases, J. L. Gressitt. Adams I: L. Turbott, on stones in outlet stream, in pools with slimeweed, 27.I.1966, 2 larvae; L. Turbott, on stones in outlet stream, 27.I.1966, 1 larva; Wise. (E.D.) Enderby I: stream from lake, 2.I.1963, 13 larvae, 18 pupal cases; Dumbleton. Auckland I: Ranui stream, 28.XII. 1962, 3 larvae, 31.XII.1962, 1 larva; Grey Duck Creek, 9.I.1963, 1 pupa; Deas Head, 19.I.1963, 1 larva; Dumbleton.

This species is closest to *Costachorema psaroptera* McFarlane, 1939, from

which it differs in lacking white hairs on the head, and in the form of the ♂ genitalia; the basal joint of the inferior appendages is somewhat rounded apically and the distal joint is approximately half its length thereby being intermediate in proportion between *C. psaroptera* and *Costachorema xanthoptera* McFarlane, 1939.

The larva is close to the larva of *C. psaroptera* as described and figured by McFarlane (1951).

All immature specimens taken by me were near sea-level (under 10 m a.s.l.) in streams in the open close to the shore (within 10 m of beach or shore platform), but others may have taken them from partially shaded streams.

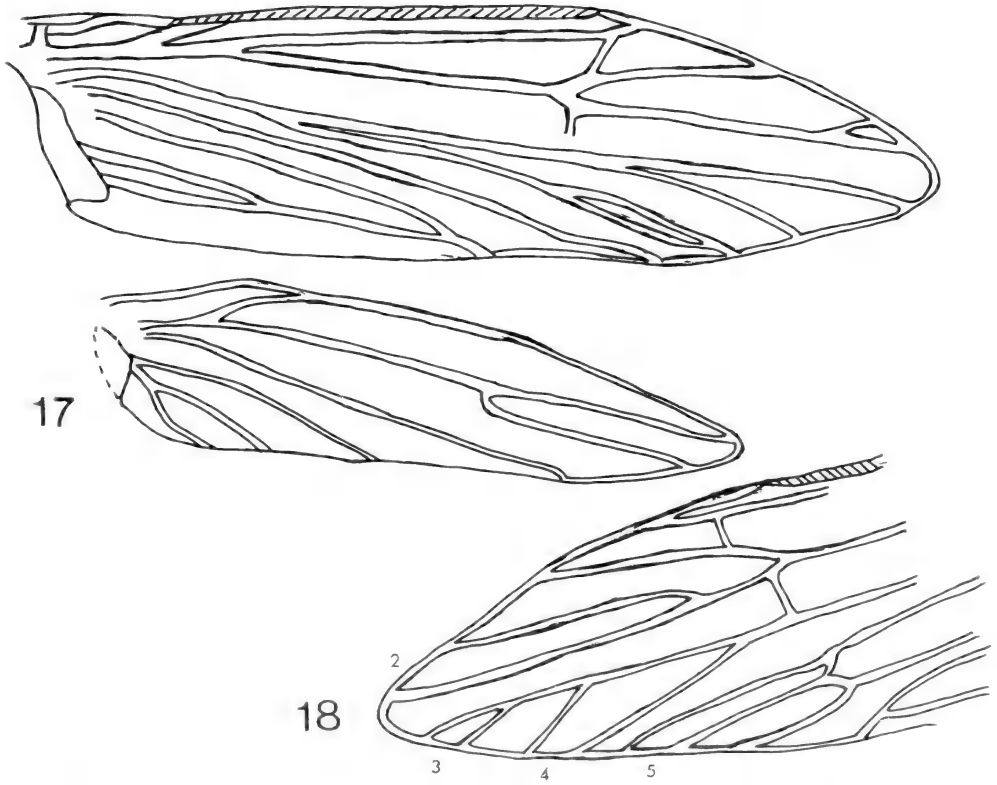
The species is named for its southern occurrence.

Genus **Tiphobiosis** Tillyard, 1924

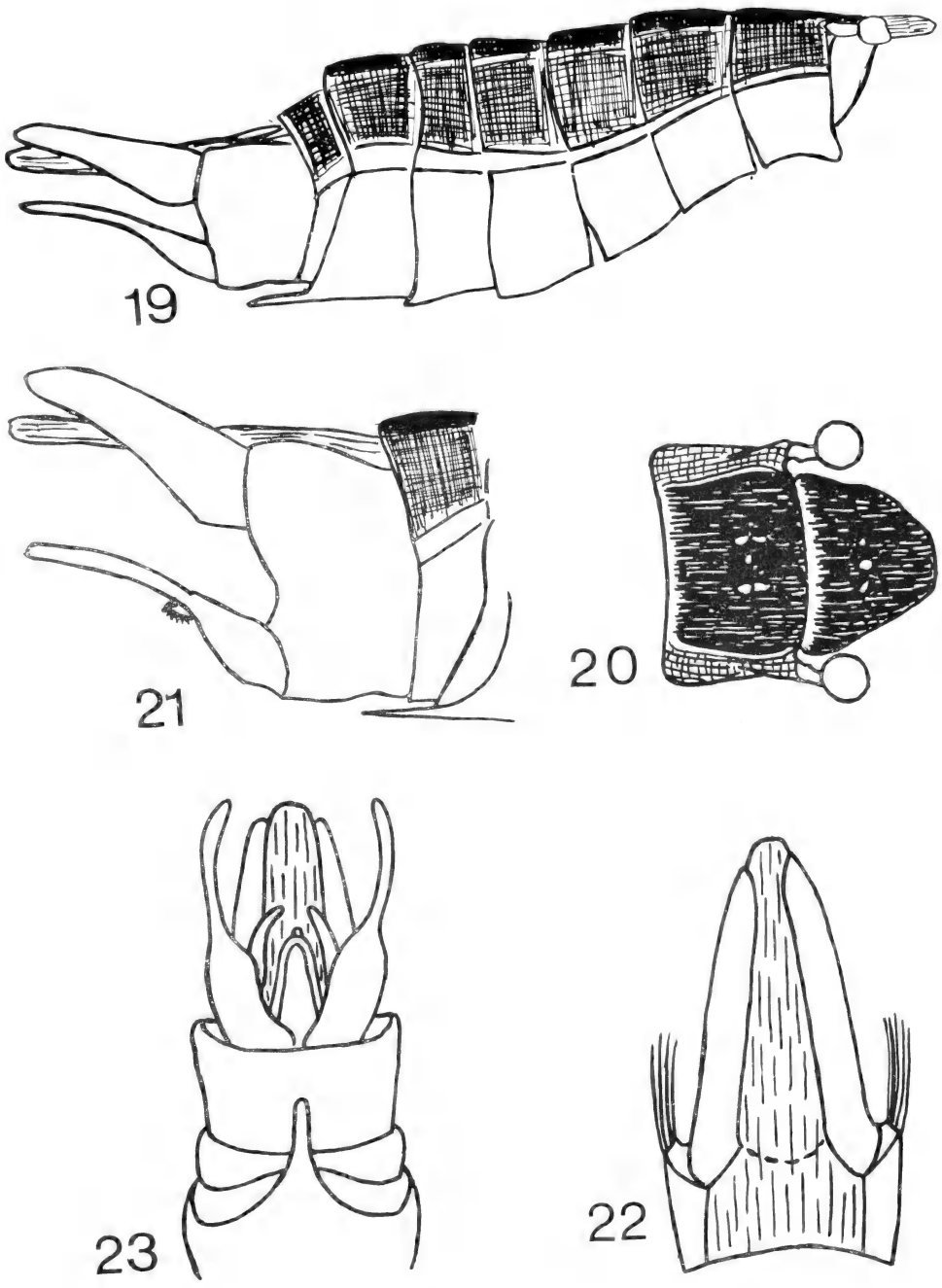
Wings, ♂. Wings and venation reduced in a southern islands species, with apical fork 1 absent from both anterior and posterior wings.

Tiphobiosis kuscheli Wise, n.sp. (Figs. 17-23)

A small pale species with dark dorsal surface of abdomen, known only from the unique ♂ holotype.



Figs. 17, 18. *Tiphobiosis kuscheli* Wise, n. sp. 17. ♂ right wings. 18. ♂ left anterior wing, apical half.



Figs. 19-23. *Tiphobiosis kuscheli* Wise, n. sp. 19. ♂ abdomen, lateral. 20. ♂ abdominal segments I, II, dorsal. 21. ♂ genitalia, lateral 22. ♂ genitalia, dorsal. 23. ♂ genitalia, ventral.

Wings, ♂ (Figs. 17, 18). Reduced, not reaching beyond end of abdomen. Costa of anterior wing with fold. Venation reduced, particularly in posterior wings and in right

anterior wing of holotype. Discoidal cell of anterior wing open. Apical fork 1 absent from all wings; apical forks 2, 3, 4, 5 present in left anterior wing of holotype. Posterior wings narrow, elongate, without apical forks.

Abdomen. ♂ (Figs. 19, 20). Segment II with a pair of sensory organs, VII with a long ventral process, VIII slightly produced mid-ventrally. Segments I-VIII dark above, with fine transverse and longitudinal striae dorso-laterally.

Genitalia. ♂ (Figs. 21-23). Segment IX membranous dorsally. Segment X continuous dorsally with IX in a long narrow process (dorsal plate). Superior appendages large, almost as long as dorsal plate, each with basal inwardly curved process. Inferior appendages as long as superior appendages, each consisting of basal portion from which arise a narrow elongate distal process and short internal basal process, both processes curved inwards, internal basal process with ventrally-turned setose apex. Aedeagus with blunt upturned point.

Measurements. Anterior wing, ♂ 3.5 mm; head + body, ♂ 4 mm.

Specimen examined. AUCKLAND IS. Holotype ♂. Adams I: Magnetic Station Cove, leaf litter, 29.I.1966, G. Kuschel. Lodged in Entomology Division, Nelson, N.Z.

Tiphobiosis kuscheli is separated from other species of the genus by the reduction in wings and venation, the lack of apical fork 1 in all wings and by the form of the ♂ genitalia; in particular, it is separated from *T. plicosta* McFarlane, 1960, by the form of the inferior appendages in lateral view, the distal process being narrow throughout its length and not expanded distally as in *plicosta*.

This species obviously belongs to the *Tiphobiosis* group and despite the lack of apical fork I in the anterior wing, I have decided to place it in the genus *Tiphobiosis*. If there was to be any separation of the species known at present, it might be more appropriate to place *kuscheli* and *plicosta* in one group on the grounds of the presence of the costal fold in the anterior wing and the sensory processes of Abd. II, of males, rather than separate *kuscheli from* the others. However, reduction of wings, and consequently venation, is well-known in insects of southern islands and I prefer to widen the scope of the genus rather than describe a new one. The present species traces to *Tiphobiosis* in the Mosely & Kimmins key to genera of Hydrobiosinae (Mosely & Kimmins 1953) and all that is required to include it in that genus is to record the possible reduction of wing venation and absence of apical fork 1.

The species is named in honour of the collector, Dr. G. Kuschel, who has done much collection and research of southern faunas.

Family HYDROPTILIDAE

Genus **Oxyethira** Eaton, 1873

Oxyethira albiceps (McLachlan, 1862) (Fig. 24)

Hydroptila albiceps McLachlan, 1862, Trans. Ent. Soc. Lond. 3 (1): 304.

LARVAL-PUPAL CASES (Fig. 24)

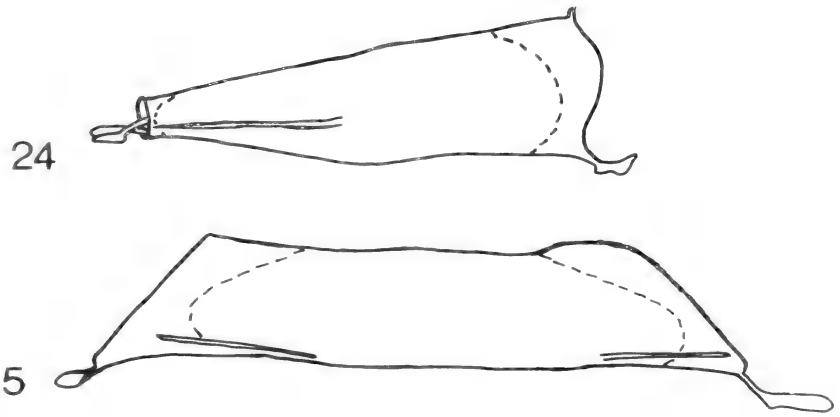
Bottle-shaped, with short non-projecting ridge on each side at narrow end; narrow end with distal rim. Small larval cases without holdfasts, larval-pupal cases with 2-4, usually 3 or 4 at pupal stage.

Measurements. Pupal cases, length 4-5 mm.

Specimens examined. AUCKLAND IS. (B.P.B.M.) Auckland I: Tucker Point, on surface of rock pool on shore platform, 15.I.1963, 1 ♀; Tucker Point, on surface of pools in rock platform, 19.I.1963, 18 ♂ ♂ ♀ ♀; Tucker Point, about rock pools on shore platform, 19 I.1963, 7 ♂ ♂ ♀ ♀; Wise. Adams I: L. Turbott, swept beside inlet stream, 26.I.1966, 9 ♂ ♂ ♀ ♀, Wise.

Immatures. (B.P.B.M.) Auckland I: Tucker Pt., ex pools in rock platform, 19.I.1963, 97 larval-pupal cases, Wise. Adams I: L. Turbott, on stones in outlet stream, in pools with slimeweed, 27.I.1966, 4 larval-pupal cases, Wise.

A previous record of this species on Auckland I. (Wise,1964), was based on the above specimens collected in 1963.



Figs. 24, 25. Larval-pupal cases. 24. *Oxyethira albiceps* (McL., 1862). 25. *Paroxyethira* sp.

Genus **Paroxyethira** Mosely, 1924

Paroxyethira sp. (Fig. 25)

PUPAL CASE (Fig. 25)

Purse-shaped, with short ridge on each side at each end of long edge; each ridge extending as a projection towards adjacent end of case. Two holdfasts, one at each end of long edge.

Measurements. Pupal cases, length 5-6 mm.

Specimens examined. AUCKLAND IS. Immatures. (B.P.B.M.) Adams I: L. Turbott, on stones in outlet stream, in pools with slimeweed, 27.I.1966, 7 larval-pupal cases, Wise.

The larval-pupal cases are of typical shape for the genus *Paroxyethira* and are quite distinct from those of *Oxyethira albiceps*.

Ecology

Some description of aquatic environments, and lists of aquatic insects, have already been given by Gressitt & Wise (1971).

On Enderby I, *Costachorema notoptera* immatures occurred in short open streams above the southern shore-line. In one pond near the shore (Fig. 26) no insects were found, but in the short open outlet stream, flowing from the pond to the nearby shore platform (Fig. 27), immatures were numerous together with immature Diptera: Simuliidae and Plecoptera. Immatures of this caddis species were taken from a similar short, open rocky outlet stream at L. Turbott on Adams I. but were also found in some partially shaded streams on the main Auckland I.

At the north end of Auckland I, immatures of *Oxyethira albiceps* were present in an unusual situation in seepage pools on the open shore rock platform (Figs. 28, 29). There was no flow of water through these pools at the time but rain, which is frequent in the area, would provide this, and slimeweed, on which this species lives, was thick in the pools. Immatures also occurred in pools with flowing water and slimeweed at the head of the outlet stream of L. Turbott.

One adult *Tiphobiosis kuscheli* was extracted from a leaf litter sample, of long grasses mixed with other plants, taken in Magnetic Cove on the north side of Adams I (Fig. 30), and it can be presumed that this individual had originated from some nearby stream before falling to the ground or into the sample. However, no immature Trichoptera were found in streams examined on the north side of Adams I, although a mature *Costachorema notoptera* was collected at the west end of the island.

On the southern side of Adams I, L. Turbott lies at the bottom of a small glacial valley (Fig. 31), approximately 6 m above sea-level. *Oxyethira albiceps* was flying over the shaded inlet stream (Fig. 32), and pools with slimeweed may occur further upstream. Midges, sandflies, mayflies, and stoneflies were also flying about the inlet stream and lake. The lake outlet stream flows rapidly in a short, steep rocky bed to the sea, but from the lake edge (Fig. 33) the stream flows more slowly at the sides through pools with slimeweed. Here, immatures of *Costachorema notoptera*, *Oxyethira albiceps*, and *Paroxyethira* sp., were found together with immatures of Plecoptera, Diptera: Simuliidae and Chironomidae, and also with Acari and freshwater Mollusca.

Most *Costachorema*, *Tiphobiosis*, and *Paroxyethira* are coldwater species found in the South I of New Zealand, but some occur in the North I and *Oxyethira albiceps* is widely distributed throughout both.

Acknowledgements. Dr J. Linsley Gressitt, Bernice P. Bishop Museum, Honolulu, supplied opportunities for both collecting and examining much of the above material; other specimens were supplied by Dr G. Kuschel, Entomology Division, Nelson, L. J. Dumbleton, Entomology Division, Lincoln, and P. M. Johns, University of Canterbury, Christchurch. Figures have been prepared for publication by Mrs A. McBirney and Miss I. Bertrand, Auckland Institute and Museum.

Fig. 26. Enderby I. Pond on south side. (Photo: Wise, 18.I.1963.)

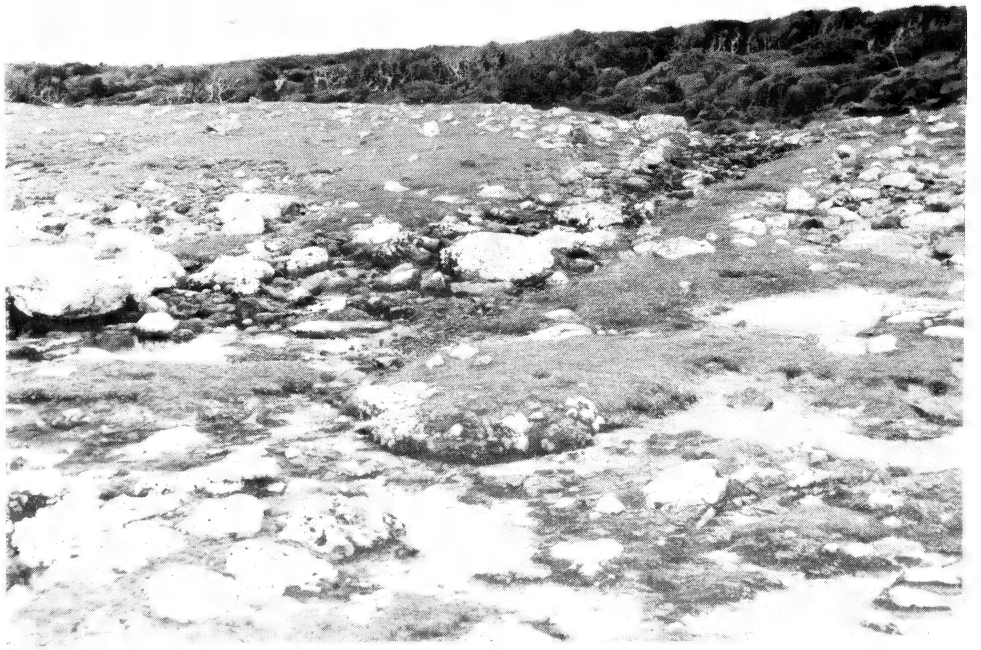


Fig. 27. Enderby I. Outlet stream from pond to shore platform. (Photo: Wise, 18.I.1963.)

Fig. 28. Auckland I. C. Crozier. Pool on shore platform. (Photo: Wise, 20.I.1963.)

Fig. 29. Auckland I. C. Crozier. Shore platform. (Photo: Wise, 20.I.1963.)

Fig. 30. Adams I. View of northern coast with Magnetic Cove right of centre. (Photo: Wise, 4.II.1966.)

Fig. 31. Adams I. L. Turbott in glacial valley on southern side. (Photo: Wise, 27.I.1966.)

Fig. 32. Adams I. Head of L. Turbott (right) with shaded inlet stream (entering from left). (Photo: Wise, 26.I.1966.)

Fig. 33. Adams I. Outlet of L. Turbott. (Photo: Wise, 27.I.1966.)

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NEUROPTERA OF THE KERMADEC ISLANDS

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Abstract. The species *Cryptoscenea australiensis* (Enderlein, 1906) (Coniopterygidae), *Drepanacra binocula* (Newman, 1838), *Micromus tasmaniae* (Walker, 1860) (Hemerobiidae) and *Chrysopa basalis* Walker, 1853 (Chrysopidae) are recorded, the last being the only natural occurrence of the family Chrysopidae in the New Zealand sub-region.

Of the four species recorded here from the Kermadec Is, only one, *Drepanacra binocula* (Newm., 1838), has previously been recorded (Tillyard 1926, Wise 1963).

Specimens of three species were taken during W. R. B. Oliver's expedition in 1908. Specimens taken in more recent years have been collected by occasional visitors or those associated with the Raoul I Meteorological Station, by a Bernice P. Bishop Museum representative in 1962, and by members of the Ornithological Society of New Zealand Kermadec Islands Expedition, 1967.

Specimens examined are from the collections of Canterbury Museum, Christchurch (C.M.), Dominion Museum, Wellington (D.M.), Entomology Division, Nelson (E.D.), and Bernice P. Bishop Museum, Honolulu (B.P.B.M.). A representative series will be lodged in Auckland Museum.

Family CONIOPTERYGIDAE

Genus **Cryptoscenea** Enderlein, 1914

Cryptoscenea australiensis (Enderlein, 1906)

Helicoconis australiensis Enderlein, 1906, Zool. Jb. (Syst.) 23: 232.

Specimens examined. KERMADEC IS. (B.P.B.M.) Raoul I: Slopes, 200 m, light trap, 3-5.X.1962, (1 ♀); N. Slopes Ridge, 200 m, Malaise trap, 22-30.IX. 1962, (1 ♀); G. A. Samuelson.

Previously known from Australia and New Zealand.

Family HEMEROBIIDAE

Genus **Drepanacra** Tillyard, 1916

Drepanacra binocula (Newman, 1838)

Drepanepteryx binoculus Newman, 1838, Ent. Mag. 5: 400.

Specimens examined. KERMADEC IS. (D.M.) Kermadec Is: No. 8, 1908, (2). (B.P.B.M.) Raoul I: Blue Lake, N. Shore, 3 m, Malaise trap, 12-25.X.1962, (4); N. Slopes Ridge, 150 m, light trap, 6-11 X.1962, (1); Low Flat, 75 m, in flowers *Melicytus*, 27.X.1962, (1); Samuelson.

The two specimens in the D.M. collection were apparently taken by Oliver's 1908 expedition.

This species is recorded from Australia, Lord Howe I, Norfolk I, Kermadec Is, New Zealand, and Chatham Is.

Genus **Micromus** Rambur, 1842

Micromus tasmaniae (Walker, 1860)

Hemerobius tasmaniae Walker, 1860, Trans. Ent. Soc. Lond. (N.S.) 5: 186.

Specimens examined. KERMADEC IS. (C.M.) Sunday I: No. 6 (1). (D.M.) Kermadec Is: No. 6, 1908 (2 ♀ ♀). (B.P.B.M.) Raoul I: Sentinel Pk. 200 m, *Ageratum* & *Stenotaphrum*, 7.X.1962, (4 ♀ ♀); N. Beach Ravine, 75 m, sweeping *Ageratum conyzoides*, 27.X.1962, (1 ♂ 2 ♀ ♀); Blue Lake, N. shore, 3 m, Malaise trap, 12 - 25.X.1962, (1 ♀); N. Terrace, 75 m, light trap, 3 - 6.IX.1962, (1 ♂); Low Flat, 30 m, sweeping *Ageratum conyzoides*, 26.IX.1962, (2 ♀ ♀); Low Flats, 10 m, sweeping ?Rubiaceae, 21.IX.1962, (1 ♀); Bell's Ravine, 75 m, sweeping *Coriasia* & *Ageratum*, 10.IX.1962, (1 ♀); Pumice Flat, 5 m, sweeping *Metrosideros* scrub, & *Ageratum*, 9.IX.1962, (1 ♀); Blue Lake, N. shore, 3 m, sweeping ferns & *Ageratum conyzoides*, 3.IX.1962, (1 ♀); Orchard area, 100 m, sweeping *Ageratum conyzoides*, 10.IX.1962, (1 ♀); Bell's Ravine, 75 m, Malaise trap, 13-22.IX.1962, (1 ♀); N.E. Slopes Ravine, 200 m, Malaise trap, 27.X. - 5.XI. 1962, (1 ♂); N. Terrace, 100 m, sweeping *Ageratum conyzoides*, 22.IX.1962 (1 ♂ 2 ♀ ♀); Samuelson. S. Meyer I: W. Slopes, 50 m, sweeping, 15.X.1962, (1 ♀); Samuelson.

The three specimens in the C.M. and D.M. collections are mounted in the same style with the same handwriting on the labels, and, presumably, were all taken during Oliver's 1908 expedition.

The species is widespread in Australian and New Zealand areas and is also recorded from Norfolk I, New Caledonia, and New Hebrides.

HEMEROBIID LARVAE

Specimens examined. KERMADEC IS. (E.D.) Raoul I : Denham Bay, swept. 17.XI.1966, (1). J. C. Watt. S. Meyer I. : beaten from *Myoporum laetum*, 28.XII.1966, (3), Watt.

These larvae all have the appearance of *M. tasmaniae* larvae, and *M. tasmaniae* is the only Hemerobiid species so far found on S. Meyer I, but I am not familiar with larvae of *D. binocula* and cannot be certain of their identity.

Family CHRYSOPIDAE

Genus **Chrysopa** Leach, 1815

Chrysopa basalis Walker, 1853

Chrysopa basalis Walker, 1853, Cat. Neuropt. Brit. Mus. 2: 239.

Specimens examined. KERMADEC IS. (D.M.) Kermadec Is. : No 5 (1 ♂ 2 ♀ ♀) : no data (1 ♂). Raoul I : 7.V.1940, (1 ♀), Lukins : 21.VI.1944, (1 ♀); 2.VIII.1944 (1 ♀); J. H. Sorenson. (B.P.B.M.) Raoul I : Low Flat, 30 m, beating *Myoporum laetum,* 18.IX.1962 (1 ♀); Pumice Flat, 5 m, sweeping *Metrosideros* scrub & *Ageratum,* 9.IX.1962, (1 ♀); Bell's Ravine, 75 m, sweeping *Coriasia* & *Ageratum,* 10.IX.1962, (2 ♀ ♀); N. Slopes Ridge, 150 m, light trap, 6 - 11.X.1962, (1 ♂ 3 ♀ ♀); N.E. Crater Slopes 75m, in flowers *Melicytus,* 23.X.1962, (1 ♀); N. Slopes, 200 m, light trap, 13-23.X.1962 (4 ♂ ♂ 9 ♀ ♀); N. Crater rim, 100 m, foliage *Solanum nigrum,* 11.X.1962, (1 ♀); N.E. Slopes Ravine, 200 m, light trap, 27.X-5.XI.1962, (3 ♀ ♀); N. Slopes, 200 m, light trap, 3-11.X.1962, (1 ♂); Samuelson. (E.D.) Raoul I : Denham Bay, swept, 17.XI.1966, (1 ♀); at kerosene lamp, –XI.1966, (1 ♂); beaten from *Melicytus ramiflorus,* 2.XII.1966, (1 ♂); beaten from *Coriaria arborea* var. *kermadecensis,* 8.XII.1966, (3 ♂ ♂ 1 ♀); beaten from *Myoporum laetum,* 8.XII.1966, (1 ♀); Low Flat, in m/v light trap, 3.I.1967, (3 ♀ ♀), 5.I.1967, (1 ♂ 1 ♀); Watt:–.1967, (1 ♀), D. E. Crockett : –.1967, (1 ♀), A. T. Blake. Meyer I : swept, 30.XII.1966, (1 ♂), Watt.

Immatures. (E.D.) Raoul I : Denham Bay, swept, 17.XI.1966, (1); swept from roadside weeds, 24.XI.1966, (2); beaten from *Metrosideros kermadecensis,* 2.XII. 1966, (5); beaten from *Melicytus ramiflorus,* 2.XII. 1966, (8); beaten from *Myrsine kermadecensis,* 8.XII.1966, (3); beaten from *Myoporum laetum,* 8.XII.1966, (5); beaten from *Coriaria arborea* var. *kermadecensis,* 8.XII.1966, (1); Low Flat, beaten from *Macropiper excelsum,* 10.XII.1966, (2); beaten from *Bochmenia dealbata,* 21.XII.1966, (1); Bells Flat, forest litter, 3.I.1967, (1); Denham Bay, on *Formes applantus* on dead *Myoporum laetum* 14.I.1967, (1); Watt : -.IX. - .X. 1966, (1), A. T. Blake : Denham Bay, -.XII.1966, (1), J. Pearl. Meyer I : beaten from *Metrosideros kermadecensis,* 28.XII.1966, (1), Watt.

The three D.M. specimens labelled "Kermadec Is. No. 5" were also apparently collected by the 1908 Oliver expedition.

This is the first record of the family Chrysopidae occurring naturally in the New Zealand sub-region; *C. basalis* is recorded (Adams 1959) throughout the Pacific area from the Philippines in the west to Easter I in the east, including Australia. Of the Pacific Is, the Kermadec Is are the furthest south, although they are only a few degrees further south than Easter I.

There is some variation in the wing venation of this species as indicated by the figures published by various authors (Esben-Petersen 1928, *C. skottsbergi,* Samoa; Zimmerman 1957, *C. microphya,* Hawaii; Adams 1959, *C. basalis,* Palau), and that of the Kermadec Is specimens is closest to that figured by Zimmerman from a Hawaiian specimen.

Discussion

Three of the four species recorded, *D. binocula*, *M. tasmaniae* (Hemerobiidae), and *C. basalis* (Chrysopidae), appear to be long established as they are common in other areas, were all taken in 1908, and are still present. The fourth species, *C. australiensis*, although only recorded in New Zealand in 1962 (Kimmins & Wise 1962), is known to have been present in the North I in 1921 (Wise 1963) and has only rarely been taken since. It may similarly be either of more recent introduction or of more restricted occurrence on the Kermadec Is.

The Coniopterygid and Hemerobiid species suggest an Australian-New Zealand influence on the Kermadec Is fauna and the Chrysopid species an Australian-oceanic influence.

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